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VOL. X. NEW YORK, DEC. 17, 1887. No. 25.

Now that the anticipations of Professor Forbes' meter have all—or nearly all—been brought to light, it is refreshing to note that an addition in the line of improvement is heralded. Elsewhere Mr. R. M. Hunter points out that in its present shape the apparatus of Professor Forbes lacks the means of indicating any disarrangement in its parts which might interfere with its registration of the current consumed. Mr. Hunter describes a remedy which seems applicable to the purpose, and, as he suggests, other methods might be adopted to effect the same result which he considers desirable to reach in meters of this class.

WHILE the larger cities of this country are engaged in the work of remedying the unsightliness and danger of overhead wires, the railroad companies have not been blind to the fact that the condition of the pole lines running alongside their tracks could be largely improved. The Boston & Albany Railroad especially, whose entire electrical equipment is an admirable one has partly, on account of the appearance, partly to improve the working of electric signals, but principally on account of the danger of such crossings, had removed within the past few years most of the straggling wires which formerly crossed its tracks; and those which must cross are grouped together as much as possible and securely fastened to strong fixtures at a greater height over the tracks than is ordinarily the case, or put under ground. This work is one which may well be brought to the attention of other railroad companies who can, with judicious management and small expense, greatly enhance the safety, not only of their patrons, but of their employés as well, besides improving the appearance of their roads.

THOUGH the dynamo is still young in its various applications it may be said to have developed a number of diseases, the nature of which it is well for those in charge of these machines to know so that a remedy may be quickly applied. The diseases may be classed, generally, as either constitutional or acquired, and as Prof. S. P. Thompson shows can be cured if we only know their nature. The constitutional diseases are due as a rule to bad construction and may not develop till after considerable time, and they are usually the most troublesome to deal with. The acquired diseases, as enumerated, it would be well for every electric light superintendent to memorize so that he may act promptly at the first symptom of ailment. Some forms of machine are, of course, more liable to be affected by one kind of disease than others. Prof. Thompson remarks that a better knowledge of dynamo pathology will lead to a better system of dynamo therapeutics. We would only add that in some cases a thorough system of dynamo hygiene would prevent many of the diseases, on the old rule that an ounce of prevention is worth more than a pound of cure.

BEARING closely upon the question of the relative efficiency of alternating and continuous current machines, or rather the losses met with in each, is the article by Dr. Louis Duncan, printed in another column. The author points out the various items which go to make up the aggregate, but we would note here one of the causes of loss under certain conditions which, we believe, has not generally been alluded to, and that is that a hot dynamo is not as efficient as the same machine when running cold. The reason for this is obvious when we consider that the magnetic capacity of iron diminishes as the temperature increases—at red heat losing its magnetizability entirely. While in well designed machines the heating of the pole pieces and armature amounts to but very little, dynamos not infrequently become quite warm, and it is probable that the strength of the magnets is decreased thereby. The limits within which a dynamo would be allowed to heat makes this loss probably quite small, but it seems to be a matter worth calling attention to at a time when all manner of pains and precautions are taken to increase the efficiency of dynamos.

THE evils connected with a makeshift system of subway work are very serious and hard to exaggerate, and yet to touch upon them seems often to put one in the position of being opposed to underground wires as such. This is, of course, an injustice, and we regret to know that not a few local electric light companies have been sufferers because, though not seeing their way to a complete system, they were forced into spending their money on useless halfway measures. The money that electric companies all over the country have spent in trying to ascertain, for their own information and with the best will in the world, just how far they could go in burying their wires, would already make a huge sum, and yet probably all the way from 50 to 75 per cent. of the outlay has been absolutely wasted. General Newton, the present Commissioner of Public Works of this city, has, we are glad to note, a clear appreciation of the fact that haste is not speed in this matter. He says, and we did not expect a public official to go so far: "The electric subways are as yet but an expensive experiment. I very much believe they will never work properly until they shall be laid in tunnels in which they can be easily reached for all necessary purposes. They cost, as they are, a great deal of money, so much, in my judgment, as to have warranted a little greater outlay to make the plant permanent. An immense saving in the probable cost of extension, maintenance and repairs would have resulted." And who will say that the Commissioner is not right?

IN the paper read by Mr. Wm. Stanley, Jr., before the American Institute of Electrical Engineers, the author throws down the gauntlet to the adversaries of the alternate current machine by stating boldly his conviction that the latter is more efficient than the continuous current machine. He bases his argument upon a mathematical demonstration that the theoretical loss of energy in the armature of both machines is primarily identical. He then points to the waste of energy which occurs in continuous current machines when a coil is short circuited by the brush, and offsets this by claiming that the alleged losses due to self-induction and Foucault currents caused by the periodic polarization of the armature are not a cause of waste, but that, on the contrary, their energy is restored to the circuit and does useful work. While we believe that the alternate current machine has been improved considerably in the last few years, and can still be improved, the statement that the alternate current machine is more economical, or, in other words, has a greater efficiency than the continuous current, seems to us still open to grave doubts. No amount of discussion or demonstration in this matter can override the test of actual experiment, which must be the final appeal in all such arguments. We have not up to the present time of writing heard of any alternating machine which approached, let alone exceeded, the efficiency of continuous current machines, according to trustworthy tests. Until actual tests demonstrate Mr. Stanley's theory of the action of the self-induced currents, one must perforce for the present continue to consider them prejudicial to the efficiency of the machine and among the things to be avoided in dynamo construction. Mr. Stanley's paper is nevertheless most instructive, and gave rise to a very lively and interesting discussion, which lack of space prevents us from producing in this issue.

THE subject of patent law revision, which is to be brought before the American Institute of Electrical Engineers next Tuesday evening by Mr. Arthur Steuart, is one whose importance it would be difficult to over-estimate. From time to time the Institute has considered this question in discussing valuable papers presented before it by Mr. C. J. Kintner, Mr. Frankland Jannus and Mr. A. C. Fowler, but the movement now brought to notice aims at crystallizing discussion in legislation, the National Electric Light Association having, through its special committee, gone so far as to prepare a bill providing for the appointment of a commission which shall undertake a general revision of the patent law. No doubt the meeting next week will be of a very interesting nature. Proud as we all are of the American patent system, we are also all ready with measures for its improvement, but it is believed by many that the reforms desirable can be attained without legislation. In fact, some authorities deprecate an appeal to Congress, on the ground that influences adverse to the patent system would at once be brought to bear upon it, to its detriment; and such opinions necessarily have their value and weight, as shown by an exceedingly pertinent and timely article on this very point in our New York contemporary, *The Electrician*. It is just such considerations, of which there many, that the meeting next week will help to place in their true light, and the fuller the discussion the clearer will be the understanding arrived at of the nature of reforms to be sought and of the best means for securing them. The interest felt by the electrical community is easily explained. All the great electrical applications of to-day are based on patents, as will be all the developments to come; and the end all are striving for is to give inventive genius its greatest encouragement, enterprising capital its greatest stability. If defects in the system are leading great inventors to make trade secrets of their processes, it would seem well to make a change; and yet if to gain minor advantages the whole patent system is to be risked hazardously, it might be wiser to stay the reformer's hand. The question invites the highest thought and judgment in the profession to its settlement.

AT no time during the past five years has there been greater activity in the electric lighting field than prevails to-day, but the industry is still in the early stages of growth, as a department offering legitimate and lucrative employment for capital. What we mean is that there is very little left of the early speculative fever, and that the erection of new plants and consolidation of old ones occupies the energies of all the leaders in the business. There were periods when it looked as though the scrambling and gambling would utterly wreck the business, but it was pulled through depression and disaster by its own inherent vitality, and stands now one of the most inviting arenas for brains, labor and money to enter. How eager they are to enter, our columns show every week. Perhaps the most significant feature of the present situation is the rapidity with which gas companies have taken up the new light. Once its fiercest opponents, they are to-day, in some cases, its warmest advocates, and the only trouble is to discover where their friendly concern is likely to end. The truth is that the manufacture of current for light and power has reached the "wholesale" point, so that stations of a capacity equal to, say, 30,000 incandescent lamps, or to 2,000 arcs, cease to be dreams, or even wonderful novelties. So long as the light, or current, was supplied on a petty, retail scale, it was uphill work for the plant, but now, when the cheerful glitter and mellow glow of the electrics greet the eye at every few steps, alike in our large and small cities, the conditions are altered vastly, and the station superintendent has a soothing, realizing sense of enhanced profits. Last week, for example, one of the big incandescent stations in this city was called upon during the gloomy weather for the delivery of over 7,000 ampères for more than six hours at a stretch; and now that electric motors are coming into universal use, both arc and incandescent stations are enabled to make better showing from continuous operation. With electric mains everywhere paralleling those for water, steam and gas, it will not be long before the public is educated up to using the current just as freely as it uses the other agencies of light, heat and power.

An Addition to the Forbes Electric Meter.

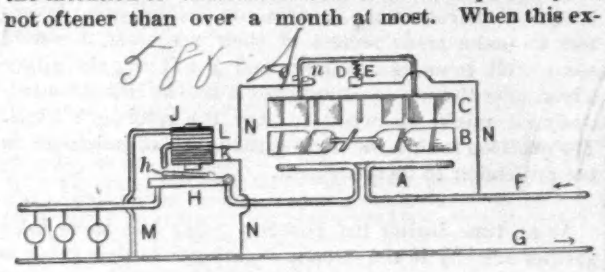
BY R. M. HUNTER, M. E.

The well-known electric meter of Prof. Forbes, which occupied such a prominent part in general discussion a short time since, seems to have an objection which I would like to point out, as I believe that it can be remedied. I could not be present at the meeting of the American Institute of Electrical Engineers when this meter was being discussed, and in reading over the minutes of the meeting I noticed that no question had been raised regarding the following fact: That if, from any cause, the mill wheel should be prevented from rotating, the current would still continue to pass and the electric light company would suffer the loss.

We all know that if a gas meter becomes deranged so as not to be able to record, the gas is automatically shut off to prevent loss to the gas company. Now, while the principle of Prof. Forbes' meter is beautiful, the action is nevertheless delicate, and, therefore, the problem I suggest of automatically arresting the flow of current with the stoppage of the rotation of the mill wheel is a very difficult one. I have given much thought to the subject, and find that it is no easy task to devise mechanism sufficiently sensitive to be controlled by the action of the delicate mill wheel power. I would like to suggest one method as an illustration.

Referring to the illustration, *A* is the heating coil; B the mill wheel, with its oblique vanes, and *C* is the cut-out wheel, with preferably substantially vertical vanes and hung on a pivot *D*. *E* is a delicate spring which holds the cut-out wheel against the stop *e*. Now the current passing in by line *F* and out by line *G* heats the coil *A* and causes the mill wheel to rotate. If, now, from any cause the mill wheel ceases to rotate, then the air currents would strike with increased force against the vanes of the cut-out wheel and cause it to move backward against the action of the delicate spring *D* until it closes the shunt circuit *N* through the high resistance coil *K* of the magnet *J*. This energizes the magnet and instantly attracts the small armature *h*, which in turn closes the shunt *M* between *F* and *G* through the low resistance coil *L* of the magnet, and this greatly increases the power of the magnet, which then lifts the large circuit, breaking armature *H* and cutting out the house circuit *I* from the line. Once it is cut out it remains cut out as long as the current is flowing, and thereby attracts attention.

This apparatus may not act with very small currents passing through *A*, but this would not matter much, as the value of the current would be small, but if a heavy current were turned on for but a short time the cut-out would act. Such a device seems necessary to a meter, as it is not the intention to examine meters more than quarterly, or not oftener than over a month at most. When this ex-



AN ADDITION TO THE FORBES METER.

amination would take place the meter would not be running, and hence the inspector would not know if it was in running order unless he passed a current through it, which it is not likely he would do, as such an act would take too much time to enable him to inspect all meters that way. An automatic device must be used to protect the electric company, for, unless this is done, the consumer might pay for little or nothing of what he was really obtaining.

Method of Finding the Resistance of an Armature When Running.

BY J. D. DALLAS AND E. C. DANBERRY.

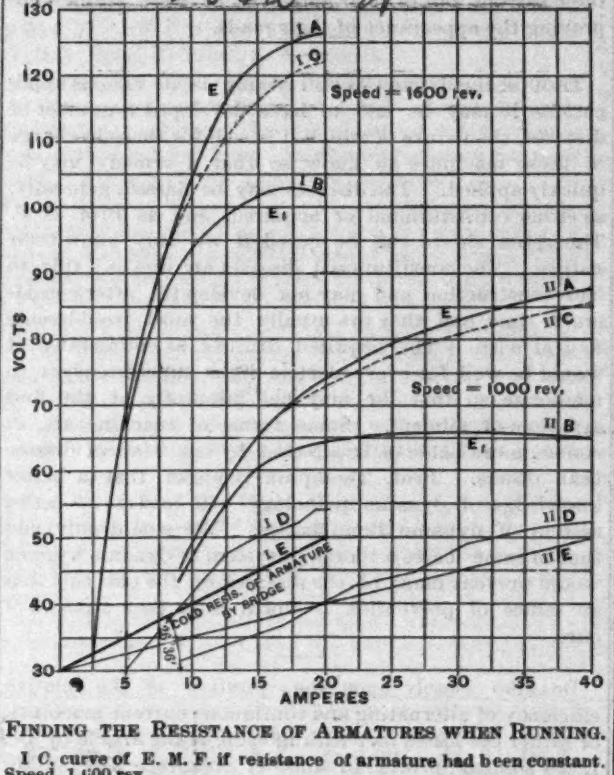
Wind on the armature an extra coil of fine German silver wire so that the number of turns corresponds to the number of turns of one coil or section of the armature. Bring the two terminals to a two-part commutator on the side of the armature opposite to that of the working commutator. Then join in series with this coil a dead beat galvanometer with a very high resistance.

In the experiment taken the resistance of the galvanometer was 23,000 ohms and that of the coil 0.5 ohm, so that the readings on the galvanometer gave the initial E. M. F. of the coil, the ratio being as 23,000 if to 23,000.5 of the true E. M. F.

To calibrate this a voltmeter was placed on the terminals of the machine, which gave the E. M. F. an open circuit. It was found that 3.8 division of the galvanometer corresponded to one volt. Readings were now taken on the machine with different currents passing through it. These were plotted with the E. M. F.'s for ordinates and the currents for abscissæ, and two curves were obtained, I *A* and I *B*, at a speed of 1,600 revolutions per number, also II *A* and II *B* at a speed of 1,000 revolutions.

Subtracting the readings of the voltmeter from those of the galvanometer gives the resistance of the armature when running in each case as shown in the curves I *D* and II *D*. The resistance of the armature having previously been carefully obtained when cold was 0.22 ohm. This, when plotted, gives curves I *E* and II *E*.

The curves I *C* and II *C* represent what the characteristic would have been had the resistance of the the armature remained constant. These were plotted by taking the ordinates obtained and subtracting I *D* from I *A*, and



FINDING THE RESISTANCE OF ARMATURES WHEN RUNNING.

I *C*, curve of E. M. F. if resistance of armature had been constant. Speed, 1,600 rev.
II *C*, curve of E. M. F. if the resistance of armature had been constant. Speed, 1,000 rev.

Resistance of machine, cold	0.49 ohm.
" " armature	0.22 "
" " series coil	0.09 "
16 series coils in parallel	0.17 "
Resistance of machine, hot	0.50 "

II *D* from II *A*, and these values being added to I *E* and II *E* respectively.

To find the resistance at any point, since $R = \frac{E}{C}$ we divide the E. M. F. by the current passing through the armature at that instant, and this gives the resistance in ohms.

The method of obtaining the increase of the internal re-

FIG. 1.—FORBES TYPE OF "IRON-CLAD" DYNAMO.

sistance by taking readings from an extra coil of wire wound on the armature of a dynamo was principally intended to be applied to machines of the Gramme ring type. The extra commutator being simply a two-part one, about one inch in breadth, which takes up but little room, and is placed in the most convenient position between the pulley bearing and armature. The unshipping of the armature can be generally accomplished by remov-

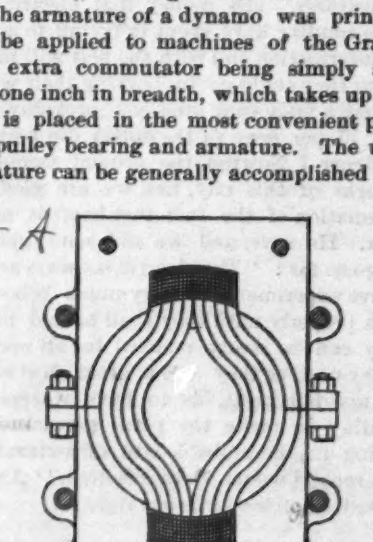


FIG. 2.—EICKEMEYER "IRON-CLAD" DYNAMO.

ing one of the bearings, and then taking out the armature shaft. In the particular dynamo in question, a Mather & Platt, this was done by first removing the pulley and then unscrewing the bolts of the bearing. The Mather-Platt has a modified form of Gramme ring. The fine coil of German silver was then wound on to the ring between two coils by removing the hub. This method may be applied to the following dynamos: The ordinary Gramme, the Wood, the Schuckert, the Edison and others. A very good illustration of the dynamo in question is to be found in S. P. Thompson's "Dynamo-Electric Machinery," page 140, Fig. 115. These experiments were made at the Central Institution, London.

An Extraordinary Mishap at a Central Lighting Station.

At a central lighting station in a certain town not far from London, a very curious accident recently occurred which very nearly caused the entire breakdown of a series-wound high-tension dynamo on a circuit of 2,000 volts. In order to see whether the pole piece was getting hot an attendant unwisely attempted to spit upon it. We say unwisely because, not being a Yankee, he had not acquired the art of spitting straight, and missing the mark, the field coil received the full benefit. The machine in question is an elderly one, and possibly the coils wanted a new coat of varnish—anyhow, in a very few minutes the cotton covering commenced to char, and a small arc began to play across the wire. It wanted still an hour to the time when the machine should stop running. By dint, however, of incessant "dabbing" with a handful of asbestos the arc was kept within limits until the evening's work was over. It was then found that the insulation had been destroyed to the depth of four layers of wire. Moral: This method of testing the temperature of pole-pieces requires some practice, and should only be undertaken by an expert.—*Lond. Electrician.*

Important Search-Light Experiments at Newcastle.

During the last fortnight of the Newcastle Exhibition a beach-light, constructed by Messrs. Clarke, Chapman, Parsons & Company, was exhibited on the watchman's tower of the old Tyne Bridge, and created a great deal of interest in the district. The lamp took a current of 100 ampères at 60 volts, so that it was nominally a 24,000-candle light. On one evening an ambulance competition was held in the grounds, and the dais on which the competitors did their work was illuminated by the search-light; but the most interesting experiments with the light were carried out by Captain Oswin Bell. Between Newcastle and Tynemouth high land intervenes, so that signals cannot be flashed direct between the coast and Newcastle. Captain Bell wished to see whether signals flashed into the sky could be read across the higher land. Accordingly, men were stationed at North Shields, Tynemouth, and along the coast as far as Blyth. The evening was very unfavorable, as there was a haze near the ground, a clear sky, and a bright moon; but Morse signals could be read in the sky at all the stations.

Types of "Iron-Clad" Machines.

To the Editor of The Electrical World:

SIR: In your issue of December 3d, Mr. Eickemeyer states that he had patented the method of winding the

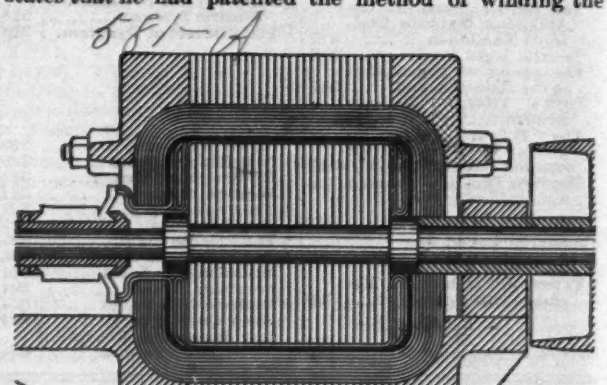


FIG. 3.—EICKEMEYER "IRON-CLAD" DYNAMO.

field magnet coils around the armature, in March, 1885. Now, in Mr. Eickemeyer's letter of Nov. 12, he makes no mention of this earlier patent, but gives the date of his patent on the machine in question as Feb. 22, 1887. The following is a short description of the other machine mentioned by me, and with which Mr. Eickemeyer states that he is unacquainted:

There are only two coils employed, which are of the usual construction, and can be wound in any ordinary lathe. Each half of the machine to the right and left of the vertical centre line is virtually a Forbes dynamo, but each coil, instead of being wound in a vertical plane having to cross the armature, is wound in a horizontal plane. To make this design economical, the diameter of the armature should be large as compared to its radial depth, and the vertical cores of the field magnets should be as short as possible, providing sufficient space is allowed for the requisite length of coil. This type of machine may be found described in Mr. Gisbert Kapp's article "On the Design and Construction of Dynamos," London *Electrician*, March 21, 1885, page 391. W. FORMAN COLLINS.

NEW YORK CITY, Dec. 1.

The accompanying engraving, Fig. 1, shows the type of machine designed by Prof. Forbes and referred to in the above letter. In order to bring out clearly the points in controversy we also reproduce the illustrations, Figs. 2 and 3, of Mr. R. Eickemeyer's dynamo. We leave the comparison of the machines to our readers.—EDS. E. W.

Efficiency and Regulation of Electric Systems.

BY DR. LOUIS DUNCAN, JOHNS HOPKINS UNIVERSITY.

The rapidity with which systems of electric lighting have been introduced in the last few years has been remarkable. The attention of the public was first attracted by the fact that electric lighting was practicable, then by the further fact that in certain cases it was economical; and now the distribution of power appeals to more than the curiosity of people of industrial pursuits, and it seems probable that electric motors will soon be in general use for many purposes. Now that it is becoming a question not of practicability, but of economy, it would not seem out of place to inquire into the conditions that regulate the cost and distribution of light and power, especially from central stations, and to attempt to point out the causes of loss of energy in electrical systems and the best way to eliminate these losses.

This is not a particularly easy investigation, in fact it is somewhat laborious; but I will, as time permits me, try to answer the subsidiary questions, and, finally, draw from these answers some conclusions bearing upon the general subject. I hope that the side issues themselves will be of some interest to electricians.

LOSSES IN DYNAMOS AT DIFFERENT LOADS.

The principal losses in a dynamo-electric machine are the following:

1. Friction; including friction of bearings and brushes, and resistance of air.
2. Eddy currents.
3. Loss in that coil of the armature which is short-circuited by the brushes.
4. Loss due to reversal of magnetism in the armature.
5. Induced currents in the pole pieces.
6. Energy of sparks.
7. Loss in field magnet coils.
8. Loss in armature coils.

These losses manifest themselves as heat.

Let us first consider a shunt-wound, constant potential dynamo, and think of the variation of these items as the load varies.

As the speed of the machine is constant and the potential at the terminals is constant the magnetic field is almost constant; it must be slightly stronger as the load increases, for the total E. M. F. must be a little greater as the current is greater; but for our purposes we may consider it constant. The speed being constant, then, if Morin's law holds for the sum of the tensions on the two sides of the belt, we have one constant for the friction.

The E. M. F. in the eddy circuit depends on the same factors that the E. M. F. of the dynamo does, and as the resistance of these circuits is constant, this loss also is constant.

The loss in the coil short-circuited by the brushes depends upon its resistance and self induction, and upon the strength and relative direction of the field. It is also affected by the current in the armature, but not to any considerable extent. These factors being constant, this loss will be constant.

The loss due to the reversal of magnetism in the armature depends upon the strength of the field and the velocity of the rotation, and is therefore constant.

The induced currents in the pole pieces of the ordinary shunt dynamo can be neglected. The loss would depend on the fluctuations in the current, which would be slight.

The loss by sparking should be inappreciable in well-constructed machines which are not overloaded. Up to a certain load, beyond which the machine should not be run, it will be very small, varying with the adjustment.

The loss in the magnet coils is nearly constant, increasing slightly with the load.

The loss in the armature coils varies as C^2.

We may consider then that the losses in a constant potential dynamo are constant, excepting only the loss due to the heating of the armature coils by the current, or we may represent the loss in h. p. as:

$$A + \frac{C^2 R}{746}$$

We should be able then from the measured efficiency at any load to deduce the approximate efficiency for any other load; providing the current in the armature is not strong enough to seriously reduce the strength of the field and cause sparking.

To appeal to experiment, I will take up the tests made by the Franklin Institute in 1885. I think the tests are more than usually accurate, because of the excellent mechanical dynamometer used, which was the instrument invented by Mr. W. P. Tatham. The armature friction was slight, since the armatures were coupled directly to the dynamometer shaft, and there was no belt to pull them up against the bearings. Indeed, it is interesting and instructive to compare the friction of the armature under these circumstances with that of the pulley of the dynamometer. The latter weighed several hundred pounds, and was tightly belted. The armature friction varied from .16 h. p. to .4 h. p. in dynamos whose armatures varied in weight from three or four to perhaps fifteen hundred pounds, while the friction of the pulley and the work absorbed in bending the belt was considerably over a horse-power, varying with the tension of the belt and the speed.

The figures I give below are from tests of two different types of dynamos. The last loads given are considerably in excess of the normal output. The results are reduced to a value of the ohm = 106.25 cm. of mercury:

EDISON NO. 4 DYNAMO.					
Power applied in h. p....	4.2	7.3	12.5	14	18
Losses except C^2R.....	1.16	1.21	1.26	1.22	1.39
WESTON 6 M. DYNAMO.					
Power applied.....	4	7	11	13	14.4
Losses except C^2R	.77	.78	.73	.91	1.04

In the last column of the Edison and the last two columns of the Weston machine, the load was greater than that normally used, and the effect of the armature current increased the loss in the field and in sparking to a considerable extent. Within the limit of ordinary use, however, we may regard the losses on different loads as approximately constant. The efficiency may then be expressed in terms of the power applied or

$$Ef. = 1 - \frac{A + C^2 R}{\text{work}}$$

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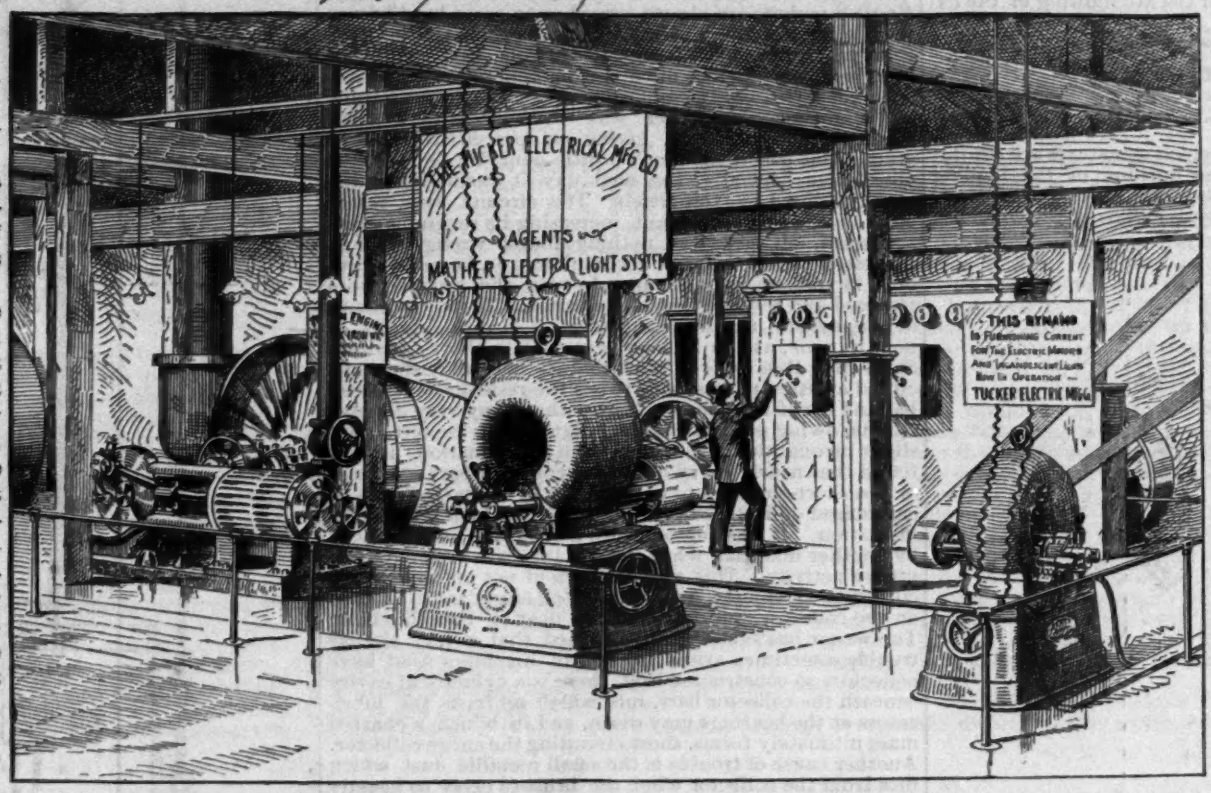


THE MATHER PLANT AT THE AMERICAN INSTITUTE ELECTRICAL EXHIBITION.

The losses in constant current dynamos vary with the method of regulation. As a large fraction of the dynamos in commercial use are regulated by shifting the brushes in such a way as to make the potential at the terminals vary with the resistance in the external circuit, I shall consider this case, supposing the machine series wound.

Here, as the current around the field magnets remains constant, we would have a constant strength of field but for the reaction of the armature. This will vary with the lead of the brushes, but in well constructed machines it should not be great. Our losses, then, should be constant, with the exception of that due to sparking and to the loss in the short circuited coil, supposing the dynamo is a closed circuit machine. Both of these last would increase as the displacement of the brushes increases, or would be greater as the load is less. As the other losses would slightly decrease it may be assumed that the loss, taking everything together, would be nearly constant; or for our purpose we can put

$$Ef. = 1 - \frac{A}{\text{work}}.$$

For the classes of machines considered, then, the efficiency will be low for small loads and will increase until effects given under 5, 6, 7 and 8 become prominent, when it will decrease again.

A Fatal Accident.—Mr. Elmer E. Wood, of the Canandaigua (N. Y.) Electric Light Company, on Sunday night, Dec. 4, noticing that a street lamp burned dimly, attempted to start the carbon. The rest is told in the press dispatch as follows: "His kid glove was wet, and, coming in contact with the magnetic part of the lamp, he received a terrible shock. He groaned, and then dropped unconscious upon the ground. When he was picked up a moment later he was dead. The only mark upon him was a small black hole in his thumb."

The Mather Plant at the American Institute Electrical Exhibition.

The large plant of the Mather system installed by the Tucker Electrical Manufacturing Company, of No. 35 Broadway, this city, for lighting the American Institute Fair buildings, which cover nearly an entire city block, has attracted so much attention that its description will no doubt be appreciated by those who did not see it in operation. Entering the lobby from the avenue, the eye was at once attracted by the flood of soft, white light proceeding from the graceful glow lamps hung in a most effective manner throughout the corridors and alcoves, lighting up every nook and corner with the brightness of day. The extreme whiteness of the light, it was explained, is due to the fact that the interior of the bulb does not blacken, owing to the freedom from deposit thereon of carbon from the filament. Passing by the general offices, board rooms, general superintendent's offices, etc., all of which were lighted by the Tucker Electrical Company, the main exhibition hall came into sight. The view from the gallery of this immense space, a perfect labyrinth of aisles and passageways, filled with throngs of humanity eager to gaze upon the many examples of progress in the arts and sciences, was one not soon forgotten. Away down to the centre of the hall was located a fine fountain, throwing its glittering spray to the roof many feet above. Around its basin were placed twelve large urns filled with choice palms, ferns and flowers of every clime. Here the Tucker Electrical Company placed a sample of the tasteful, effective work for which they are noted. In all these urns incandescent lamps were arranged, simulating in shape and color the calla lily, the crocus, the dahlia—in short almost every conceivable type of bright colored flowers. Beneath the waters of the basin, *completely submerged*, shone lights of many hues, bathing the surrounding rocks and plants in all the colors of the rainbow. Along the sides of the main hall, lighting the booths on the one hand and the road of the electric railway on the other, were about three hundred Mather lamps suspended in groups of four, with opal reflectors. The dining-room was brilliantly lighted by sixteen candle-power lamps tastefully arranged about the room on brackets extending from the walls and columns. The space occupied by the Tucker Electrical Company for their dynamos, engine, switchboard, etc., was located at the southerly end of Machinery Hall and was a model of neatness and methodical arrangement. In addition to furnishing light in the building, electrical power was supplied for operating motors to drive fans, blowers, sewing machines, etc. The plant was, taken altogether, a good illustration of the varied uses to which electricity can be put, and of the ease with which a first-class installation can be operated.

Meteorological Observatories in Japan.—*Nature* states that an imperial decree has been issued by the Mikado of Japan sanctioning regulations for the establishment of meteorological observatories at the public expense in the country. The regulations provide that the central observatory shall be situated in Tokio, and local observatories at such convenient places as may be designated by the Home Minister, without whose consent the local authorities may not establish observatories. The central observatory is to be under the Home Minister, while the local observatories are to be under the respective local governments. The cost of maintaining local observatories is to be defrayed out of local taxation; they are to communicate and correspond with the central observatory, according to departmental regulations, which shall be made by the Home Minister.

Mr. Warren Anderson, of Xenia, O., superintendent and general manager of the Miami Telephone Company, has accomplished what would hardly have been considered possible three weeks ago. He has built up the Lebanon Telephone Exchange until there are about 40 subscribers and more boxes to go in. Mr. Anderson has accomplished this by hard work and persistent personal effort. The telephone is an invention that is regarded by most persons at first as unnecessary expense, next as a desirable luxury and finally as an absolute necessity. Mr. Anderson, who is an exceedingly pleasant gentleman as well as a good business man, has labored day and night to convince the business men of Lebanon that they should possess a telephone, and his labors have been so far rewarded that there is a very creditable exchange here. He promises that the service shall be first-class, and is now making arrangements to have an operator present from seven in the morning until nine at night. We hope this may be done, as it will greatly increase the value of instruments to subscribers.—*Lebanon Gazette.*

Electric Light Mast.

At the recent Manchester Jubilee Exhibition the grounds were illuminated by lamps suspended on a special form of post possessing several novel features. Our illustrations, taken from *Industries*, represent the post in elevation and in partial vertical section respectively. Each mast consists of a wrought-iron column 50 feet high from the ground line to the finial. Within its base is a winch with a removable crank handle, shown in the elevation outside the mast. The lamps are attached by curved tubes to a cylindrical frame surrounding the mast. At the top of the mast are three radial grooved pulleys, over which pass three steel ropes. Of each of these three ropes, one end is attached to the cylindrical framing or lamp carrier, and the other end to a balance weight *A* within the mast; the balance weight finally is connected by a steel rope to the barrel of the winch. It is obvious, therefore, that by rotating the barrel of the winch in one or the other direction, the lamps may be raised or lowered at will. The arrangement for conducting the current to the lamps is very simple and effective, as it obviates the common risks of slack and exposed conductors. The cable is secured to the insulator *C*, whence the current is led by a double concentric conductor which passes under the weighted snatch block *D* and over a small grooved pulley at the top of the mast, whence it is led and secured to the framing. The circuits are completed to the lamps through the curved tubes, which the conductors enter at the lower open part *E*. The weighted snatch block *D* keeps the conductor at a uniform tension in every position of the lamps, and the wires are well protected from risk of damage by the inclosing column. These masts were designed and erected under the supervision of Mr. J. S. Raworth, engineer of the Anglo-American Brush Light Corporation, the contractors for the arc lighting of the exhibition.

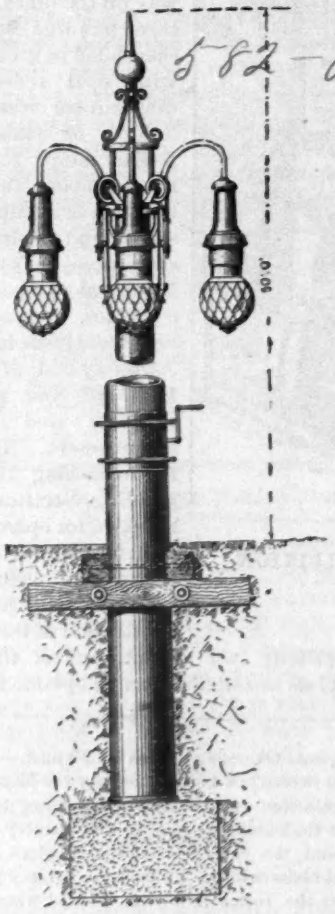


FIG. 1.—ELECTRIC LIGHT MAST.

The Diseases of Dynamos.*

BY PROF. SYLVANUS P. THOMPSON, D.SC.

Among the complaints to which armatures are subject are the burning-out of coils, the burning of the binding wire, and the breaking off of the conductors near the ends where they go to join the respective parts of the collector.

The burning-out of coils is sometimes due to short-circuiting at the collector between two adjacent sections; but often it arises from short-circuiting in the armature itself. In armatures so constructed that the windings of one section lie partly over the top of those of another section this evil is more likely to occur than in those that are not so constructed. Short-circuit between an imperfectly insulated wire and the iron core beneath it is a frequent source of trouble, and this again arises either from bad mechanical work allowing the iron laminæ to become loose or from the use of unreliable insulating materials. The burning of binding wire clearly arises from want of compliance with the necessary and sufficient electrical conditions. The fracture of the armature conductors near the ends where they turn over to the collector—a most annoying fault when it occurs—appears to be partly mechanical and partly electrical. These conductors are at this point not supported laterally: any engineer would imagine that they were strong enough to stand any longitudinal or centrifugal force to which they might be subjected. Yet they have to withstand severe lateral forces, arising from the fact that they carry strong currents and are situated in a fairly powerful part of the magnetic field, which here extends beyond the edge of the polar surfaces. Hence they are each racked by a lateral force that comes upon them twice in every revolution; and which, moreover, must strain them severely whenever the current is suddenly cut off or turned on. The collector or commutator and its brushes are a fruitful cause of trouble. Brush-holders are rarely as substantial as they should be. The conditions of good mechanical work and good electric work are here somewhat antagonistic; but the mechanical work must be good, otherwise the best observed electrical arrangements will fail. The brushes must not slip or jump with the vibrations of the machinery. If they press too heavily the surface of the collector will be torn into ruts; if too lightly, the edges of the separate sections of the collector will be bitten and rounded by sparks. The curious disease known as the occurrence of "flats" in the collector has been a source of puzzle and annoyance to many. In many cases the occurrence of a "flat" may be definitely traced to a more or less developed fault in some one section of the armature coil. A broken armature coil, the ends of which still touch against one another within their insulatory sheath, may go unsuspected; but it may have the effect—by its increased resistance—in causing an increase of spark at the brush just as it passes through the position of commutation. Hence the corresponding bar of the collector will at every half-revolution be bitten into by a spark a little more than any other bar is bitten into, and so become flattened as compared with the proper peripheral armature of its fellows. "Flats do not, however, always arise from this cause. It has been observed that a 'flat' may arise on one bar of the collector; and on turning down the surface of the collector so as to remove it, a 'flat' breaks out on another bar of the collector. A 'flat' may arise from a flaw in the metal of the bar, which passing under the brush, gives rise to a spark that bites away the metal a little further to right and left, and so spreads along the bar until the whole surface of it is more or less bitten away. A little more pressure on the brush, and a better mechanical holding of the brush, are remedies not to be despised. The collector is the one part of the machine most likely to give trouble; it is rarely made large enough; years of experience have not yet given any decisive answer to the question, what materials it should be made of? Whilst English makers are almost agreed upon some hard bronze with mica insulation, Messrs. Siemens and Halske have this year abandoned these for iron bars with air gaps between. Before mica was in general use asbestos was not infrequently employed, and with curious results. At one time the writer was working with a small Siemens shunt dynamo, giving on open circuit about 80 volts. One day it gave only a little over 70, though the speed was normal. The next day it was under 70; the next it refused to excite itself. The circuits were tested out, as a fault in the shunt, increasing its resistance, was suspected, but there was nothing found wrong. When separately excited from accumulators it, however, gave only 15 volts on open circuit. In vain the brushes were replaced and the brush-holders cleaned. There was plenty of magnetism, for the armature got hot; yet no sparks, or next to none, at the brushes, even when short-circuited. Suspecting that some of the armature coils were short-circuited, an attempt was made to test the resistances between bar and bar of the collector, but without any very decisive results, owing probably to the roughness of the test. But slight inequalities gave a clue. On examination, it was found that nearly every one of the collector bars was more or less short-circuited to its neighbor by a charred mass of carbonized oil imbibed into the asbestos which formed the insulation. It was dug out with a penknife and replaced by another material, when the dynamo was restored to its proper activity. This vice has been of not unfrequent occurrence. Obviously, in such cases, oil ought not to be used on the collector, but only asbestos dust or French chalk. The writer has subsequently learned that a very similar trouble sometimes arises in certain machines that have collectors so constructed that there is a cylindrical cavity beneath the collector bars, into which oil from the lubricators at the bearings may drain, and in which a charred mass ultimately forms, short-circuiting the entire collector. Another cause of trouble is the small metallic dust which flies from the collector when the brushes press so heavily as to produce ruts, entailing consequences partly mechanical and partly electrical that may end in a breakdown.

Among other faults of armatures that give trouble there is a purely mechanical one, arising from want of knowledge on the part of the electrical designer, namely that of not being properly balanced. Every engineer worthy the name knows that a thing so balanced as to stand in any position is not necessarily balanced for running; that a four-pound weight at three inches from the axis of rotation, though balanced statically by a one-pound weight at twelve inches from the axis, is not balanced by it dynamically, for the moments of inertia about this axis are not equal. On the contrary, a four-pound weight at five inches is balanced dynamically by a one-pound weight at ten inches from the axis. A machine that violates mechanical principles can never be satisfactory. Short bearings where long ones would be appropriate; a high-speed machine where a low-speed machine is the only suitable sort (for example, on shipboard,; inside bearings where outside ones ought to be used, and vice versa—all these things have been and may still be answerable for breakdowns. So much the more reason is there for the electrical engineer to be engineer first and electrician afterwards.

In the field magnets vices of construction are more frequent than acquired defects. Field magnet coils are sometimes wound on frames that are loose, or the coils are badly insulated. When the frames are loose the resulting vibration not unfrequently causes the ends of the wires to snap off short. If there is a single short circuit between coils and iron work in the field magnet, then a single short circuit at any other point—armature coils, collector bars, brushes, brush-holders or terminals—may work dire disaster. A little Brush machine, lent to the Finsbury Technical College by the Anglo-American Brush Corporation, had its commutator segments completely ruined in a few minutes by a curious double fault of this kind, which defied detection for several days. There were two short circuits, neither of which in itself would have done any harm whatever; but the iron support that held the rocker for one pair of brushes was so fixed by screws as to make a cross connection that short circuited two pairs out of the four pairs of coils on the armature. A short circuit between coil and iron core of the field magnet is more likely to arise in shunt machines or compound machines than in series-wound ones, owing to the much higher electromotive force of the self-induced extra current if the shunt circuit is from any cause opened. Alternate current dynamos are liable to develop different kinds of faults from those to which direct-current machines are liable. They sometimes give a curious pulsation of a determined slow period in their currents. The cause for this is probably purely mechanical. Again, machines for constant current are liable to disorders of a different order from those of machines intended for constant potential work. The latter are more liable to overheat; the former are more troublesome in respect of sparking. Very little attention seems to have been paid to the question of the goodness or badness of insulating materials for resisting being broken down under working conditions entailed by damp, dust, and oil. Under such conditions it does not in the least follow that the material showing the highest insulation tests is the best. Very few dynamos will show, even when new, an insulation resistance between iron work and copper work amounting to anything like one megohm. Yet a dynamo that showed only ten thousand ohms of insulation resistance and mechanically resisted being broken down, would be preferable to one the insulation resistance of which was a hundred megohms, if that high resistance was secured by employing brittle materials or materials that were destroyed by the presence of oil. Whether mica is in all cases preferable to asbestos, Willesden paper to vulcanized fibre, or shellac varnish to a solution of india rubber, or what other insulating materials should be prescribed in preference, can only be ascertained by a careful study of the failures that have from time to time arisen when one or other was employed. Only by the study of the malady as it arises can the proper treatment be discovered to prevent its recurrence. In short, by the proper study of dynamo-pathology, we may arrive at a fuller knowledge of dynamo-therapeutics.

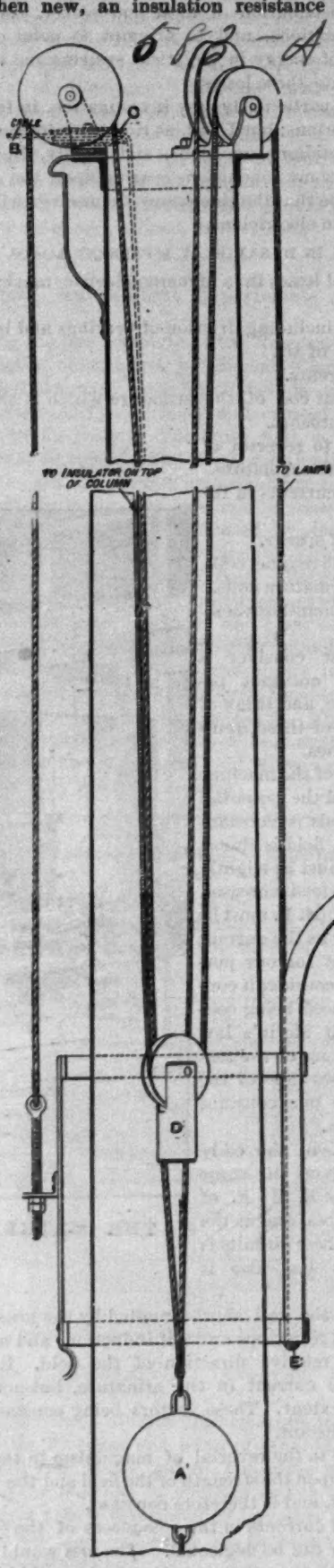


FIG. 2.—ELECTRIC LIGHT MAST.

The Storage Think-Tank.—The well known scientific writer, Bill Nye, describes in a recent issue of the New York Sunday *World* a new invention, which he ascribes to Mr. Edison and which he calls a "think-tank." It appears to have very much in common with the improved phonograph, and hence no further description is necessary at the present time.

* Abstract of a paper read before the Finsbury Technical College Old Students' Association, Nov. 29, 1887.

Phenomena of Retardation in the Induction Coil.*

BY WM. STANLEY, JR.

This paper will attempt to emphasize the time relations of the alternating E. M. F.'s. and currents in the induction coil. Any description of the phenomena of retardation accompanying the inductive effects of currents would necessarily be incomplete and unintelligible without a clear conception of the fundamental principles of the induction coil. This must be my excuse for briefly recalling to you the rudiments of the induction system.

An alternating E. M. F. differs from a direct E. M. F. in two important points: It varies continuously, and its direction or polar tendencies alternate.

To illustrate graphically the various values of an alternating E. M. F. and the attending phenomena, it is usual to plot a series of curves above and below a straight line. This line, when divided in equal divisions, may be taken to represent successive periods of time (See Fig. 1). Starting at the point *A*, the E. M. F. is seen to rise rapidly above the line *A X* in a gentle curve (the particular curvature of which depends on the construction of the generator), until at 9 it reaches its highest point; thence it flows downward in a similar but reverse curve, until it again reaches the line *A X*, and, continuing downward, finally attains a sub-maximum at *C*. From this point it rises again, crossing the line *A X* once more at *D*, whence a repetition of the former curves occur.

The E. M. F. of the alternating current at any particular time can be determined by the distance of the curved line above or below *A X* at that time. For instance, suppose we wish to determine the E. M. F. at any time, *y*. Through *y* draw *y z* perpendicular to *A X*, cutting *A* 9 at 7. Then 7 *y* represents the E. M. F. applied to the circuit at the time *y*.

From an examination of the curve it will be seen that at stated intervals of time *A*, *O*, *D*, *G*, there is no E. M. F. applied to the circuit; and, if the curves above the line *A X* represent E. M. F.'s applied in one direction, those below the line *A X* represent E. M. F.'s in the opposite direction. Hence adjacent E. M. F.'s alternate in direction, and hence the term alternating currents.

There is a general misunderstanding to the effect that the alternate current dynamo is less economical than is the direct current generator. This is not so; there is a little difference, it is true, but the difference is, I believe, in favor of the alternate current machine. Let us take a dynamo field, for example, that of a simple direct current type of dynamo, and separately excite it with a constant current; let us now wind two armatures of identical dimensions, one for direct and one for alternate currents, and arrange to run them at the same speed; and let the windings of the two armatures be identical in size and number of turns of wire. Now the E. M. F. produced in these two armatures will be found to be, for the direct current armature:

E. M. F.	*X* volts.
Resistance of the armature	*R* ohms.
Ampères per section of winding	*A* ampères.

And because the armatures are identical we have for the alternate current dynamo:

E. M. F.	2 *X* volts.
Resistance of armature	4 *R* ohms.
Ampères per section of winding	½ *A* ampères.

Thus the direct current dynamo will generate $A\ X$ watts, and the alternate current dynamo $2X \times \frac{A}{2}$ or $A\ X$ watts, also. Hence the capacities of the armatures are equal.

The loss of energy in the armatures will be, for the direct current dynamo, $A^2 R$ watts. For the alternate current dynamo $\left(\frac{A}{2}\right)^2 \times 4R$, equals $\frac{4 A^2 R}{4}$, or $A^2 R$ watts. From this we learn that the losses in the armatures

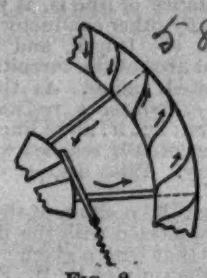


FIG. 2.

are equal. It is stated, however, that owing to self-induction, Foucault currents, or something else, these figures do not represent the actual waste of energy. The waste of energy by self-induction in the direct current dynamo occurs when a brush on the commutator touches two adjacent strips at the same time, as in Fig. 2. The arrows indicate the direction of the induced currents, and show that at that time all the E. M. F. of the short circuited coil is wasting current on a short circuit through the brush. What now is the loss in the alternate current dynamo through self-induction?

In the direct current dynamo the current flowing through the armature coils magnetizes the armature with a polar line at an angle to the polar line of the field.

FIG. 6.

These armature poles maintain a constant position relative to a fixed point, and are of a constant value. In the alternate current dynamo, the current in the armature rises above and falls below a zero value periodically; hence the iron in the armature has periodic polar tendencies at an angle to the polar line of the field.

I shall endeavor to show that instead of wasting energy by periodically polarizing the armature, the E. M. F. devoted to this purpose is at first temporarily stored and subsequently returned. As is well known, a certain period of time is required to establish a given magnetic charge in iron, which time is directly proportional to the degree of magnetization to be attained. If, therefore, we plot a curve, the abscissæ representing time and the ordinates the degree of magnetization, and if we apply this curve to the curve of E. M. F. producing it, we have two similar curves separated from one another by a given period of time, as shown in Fig. 3, where 1, 2, 3, 4, 5 represents the curve of E. M. F., and 6, 7, 8, 9, 10 the corresponding curve of magnetization.

When the coil on the alternate current armature leaves a pole of the field (during rotation) the lines of force threading it rapidly diminish, and by induction generate an E. M. F. in the coil. The rise of E. M. F. and consequent flow of current in the coil is attended by a magnetic polar effect in the iron core, which not only increases while the E. M. F. is rising from 1 to 2, but continues to increase, attaining its maximum value when the E. M. F. has fallen to *K*. Up to this time, namely, the time when the magnetic charge is maximum, energy has been expended upon the iron core; but notice, that at this time the charge on the iron core is superior to the charge producable by the E. M. F. at that instant; consequently, the charged core does positive work upon the E. M. F., if I may use the expression, and in doing this decreases its own value.

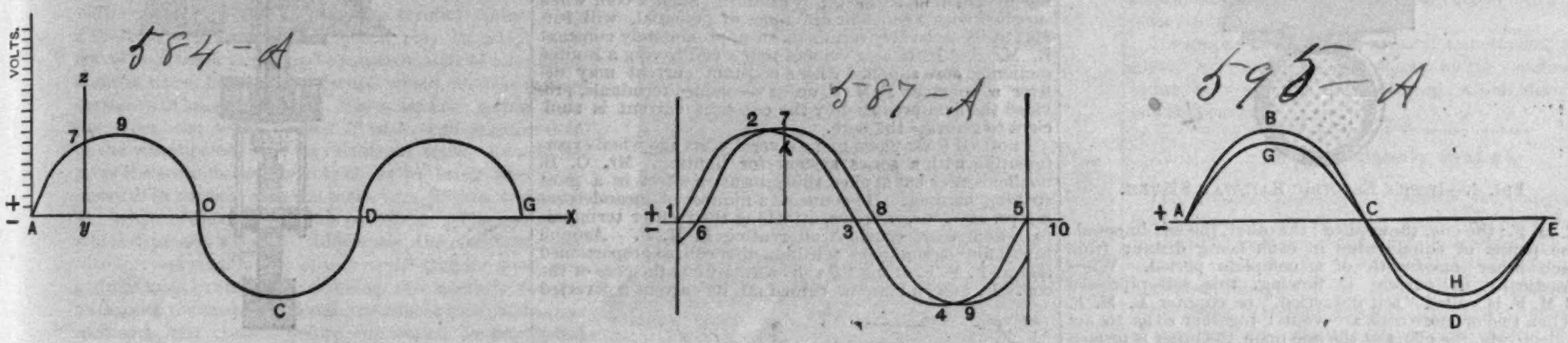
This auxiliary E. M. F. developed by the magnetized core upon the armature conductor assists the E. M. F. proper; that is, the E. M. F. developed by the field magnets. Thus the energy devoted to magnetizing the armature, during the rise of wave of E. M. F., is returned as E. M. F. during the fall of potential. We may assume that the wave is shifted along or retarded. Fig. 3 illustrates this retardation. 1, 2, 3, 4, 5, is the curve representing the position of a wave of E. M. F., without taking into consideration the effect of the iron core, while 6, 7, 8, 9, 10 is the curve-wave of E. M. F. which has been retarded, by reason of the magnetic charge on the iron from the theoretical position, 1, 2, 3, 4, 5.

The curve of E. M. F. of a coreless armature is quite different; here, as before, the theoretical curve is *A*, *B*, *C*, *D*, *E*, Fig. 4. Let us see what the effect of self-induction is in this case.

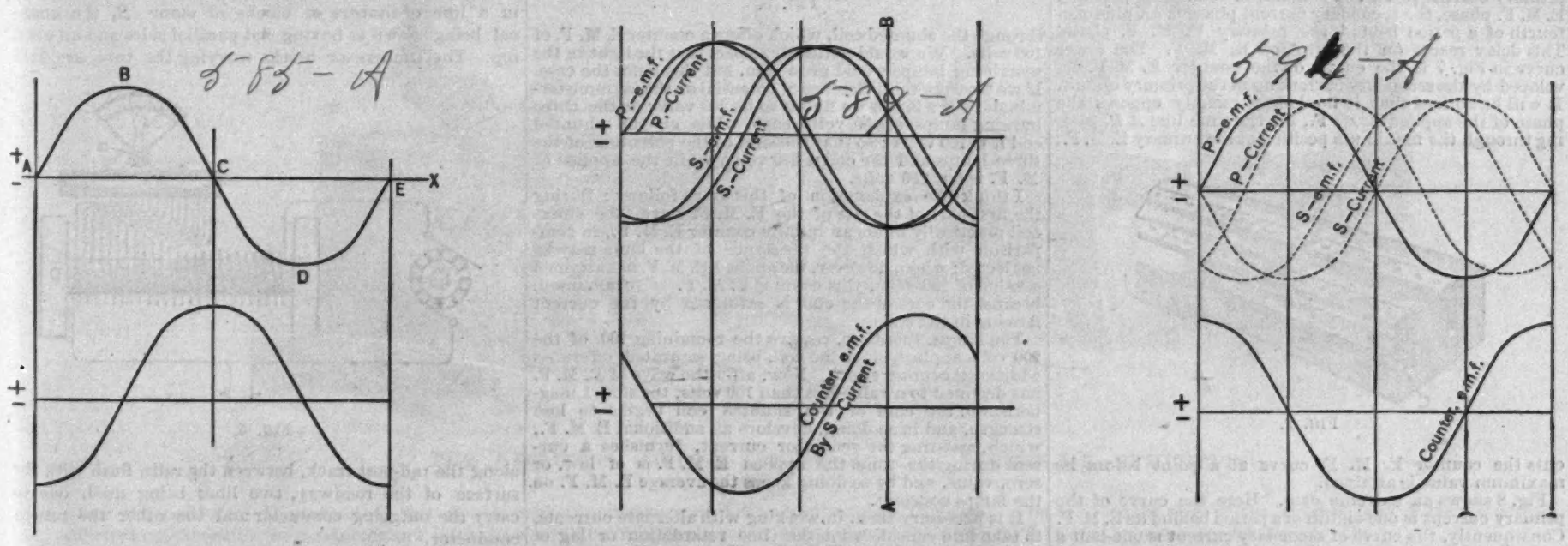
We know that self-induction is proportional, among other things, to the current flowing at a given time. Now, at the time *A* no current flows; hence, there is not self-induction. But as the E. M. F. rises, and current is driven through the coil, the self-induction or counter E. M. F. prevents the E. M. F. from attaining its theoretical value. It does not delay the E. M. F. from its theoretical time position, as is the case with an iron core, but prevents the E. M. F. from attaining its theoretical maximum value at any time. The real curve of E. M. F. in this case would be *A*, *G*, *C*, *H*, *E*, Fig. 4. This curve shows that there is no waste of energy due to counter E. M. F., but that the armature output is reduced by self-induction. An iron core, therefore, causes the counter E. M. F. to oppose the E. M. F. proper only during one-half a period, and allows it also to assist the E. M. F. proper during the other half period in the phase.

It is evident that the time of retardation, viz., the distance between 1, 2, 3, 4, 5 and 6, 7, 8, 9, 10, Fig. 3, depends on the quantity of current flowing through the armature coils as well as on the core. I have described this point at length, as there is a general, although false, impression that the iron core of an alternating armature necessarily wastes energy.

We may roughly compare the theoretical efficiencies of the direct and alternating dynamos, as follows: The output



FIGS. 1, 3 AND 4.—PHENOMENA OF RETARDATION IN THE INDUCTION COIL.



FIGS. 5, 7 AND 8.—PHENOMENA OF RETARDATION IN THE INDUCTION COIL.

*Read before the American Institute of Electrical Engineers, New York, Dec. 6, 1887.

We know that self-induction is proportional, among other things, to the current flowing at a given time. Now, at the time *A* no current flows; hence, there is not self-induction. But as the E. M. F. rises, and current is driven through the coil, the self-induction or counter E. M. F. prevents the E. M. F. from attaining its theoretical value. It does not delay the E. M. F. from its theoretical time position, as is the case with an iron core, but prevents the E. M. F. from attaining its theoretical maximum value at any time. The real curve of E. M. F. in this case would be *A*, *G*, *C*, *H*, *E*, Fig. 4. This curve shows that there is no waste of energy due to counter E. M. F., but that the armature output is reduced by self-induction. An iron core, therefore, causes the counter E. M. F. to oppose the E. M. F. proper only during one-half a period, and allows it also to assist the E. M. F. proper during the other half period in the phase.

It is evident that the time of retardation, viz., the distance between 1, 2, 3, 4, 5 and 6, 7, 8, 9, 10, Fig. 3, depends on the quantity of current flowing through the armature coils as well as on the core. I have described this point at length, as there is a general, although false, impression that the iron core of an alternating armature necessarily wastes energy.

We may roughly compare the theoretical efficiencies of the direct and alternating dynamos, as follows: The output is equal; the waste of energy in armatures due to $C^2 R$ is equal. The waste due to self-induction is greater for direct than alternating dynamos, with properly constructed iron cores.

Faraday's law of induction may be stated as follows: The variation of the magnetic field surrounding a conductor induces an E. M. F. in that conductor. A variable field is produced by a variable current, and hence, a conductor carrying an alternating current will induce an E. M. F. in another conductor residing in the same field.

Let us note the values of the E. M. F.'s in the inducing or primary, and induced or secondary circuits, at the same time, and first when no current is flowing. The curve, *A*, *B*, *C*, *D*, *E*, Fig. 5, represents, as before, the alternating applied E. M. F. Now, the induced E. M. F. will be a maximum at the time when the inductive effect of the primary

current is a maximum, and the inductive effect of the primary will be greatest when its E.M.F. is changing most rapidly. Evidently this will occur near the zero line *A X*; for the E. M. F. will vary greatest when passing from a finite value to zero, or from zero to any finite value. Hence the inductive effect of the primary and the E. M. F. developed on the secondary circuit will be a maximum when the primary E. M. F. is least.

Fig. 5 represents the time relation of the primary and secondary E. M. F.'s when no current is passing. The position of maximum E. M. F. of the secondary is, as you see, one-fourth of a complete period behind that of the primary. Now, a moment's consideration will show that the secondary circuit is simply the receptacle of an E. M. F., and, when no current is flowing in it, plays no part in the inductive phenomena.

The primary circuit evidently will induce in itself an E. M. F. in the same manner that it impresses the E. M. F. on the secondary circuit. Hence, in any circuit to which is applied an alternating E. M. F., we have two phases of

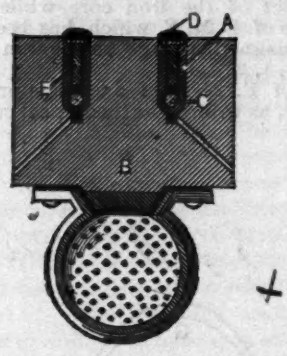


FIG. 1.—IRISH'S ELECTRIC RAILWAY SYSTEM.

E. M. F.; the one, the applied; the other, the self-imposed; the points of equal value in each being distant from each other one-fourth of a complete period. When practically no current is flowing, this self-impressed E. M. F. is called "self-induction," or counter E. M. F. When two or more coils are wound together so as to act collectively, the effect of the one upon the other is termed "mutual" induction. We now see why, when an alternating E. M. F., of, say, 1,000 volts, is suddenly applied to coil whose resistance is low, as, say, 1 ohm, the coil does not receive the quantity of current destined for it by Ohm's law. The kinetic E. M. F. is very small, because it is the difference between the applied and counter E. M. F.'s.

Fig. 6 shows a wire wound on itself or coiled. The full arrows indicate the direction of the applied E. M. F., the dotted arrows the counter E. M. F. In the two adjacent turns one impresses a counter E. M. F. on itself and also a counter E. M. F. on the other and latter again impresses a counter potential on itself and on the first. Hence in two coils of wire we have four impressed counter E. M. F's. This is commonly stated as the self-induction, and is proportional to the square of the number of turns.

We will now consider the time position of the currents flowing through coils impelled by the E. M. F's of which we have spoken, and endeavor to apply the effects of the various positions they assume to a few of the phenomena noticed in working induction coils with different current strengths.

Evidently, when little current is flowing over a conductor, the self-induction and retardation are small; hence the curve of the current nearly coincides with the curve of E. M. F. Fig. 7 illustrates the positions. Here the phase of the primary current nearly coincides with the phase of its E. M. F. The curve of the secondary E. M. F. is, however, just one-fourth of a period later than the primary current phase, while the curve of the secondary current is still farther behind it; so that, while the primary current phase is a distance *X* behind the primary E. M. F. phase, the secondary current phase is 2*X* plus one-fourth of a period behind the primary E. M. F. phase. This delay reacts on the primary E. M. F. The lower curve in Fig. 7 is the curve of the counter E. M. F. developed by the secondary current upon the primary circuit. It will be noticed that it no longer exactly opposes the phase of the applied E. M. F., for the time line *A B*, passing through the maximum position of the primary E. M. F.,

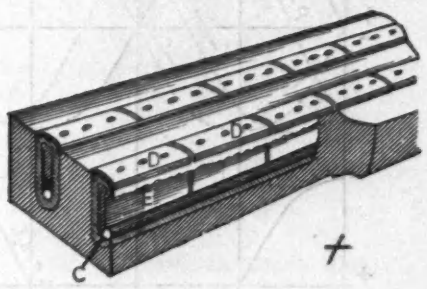


FIG. 2.

cuts the counter E. M. F. curve at a point before its maximum value is attained.

Fig. 8 shows an extreme case. Here the curve of the primary current is one-eighth of a period behind its E. M. F. Consequently, the curve of secondary current is one-half a period behind the primary E. M. F., *i. e.*, $\frac{1}{4} \times 2 + \frac{1}{4}$; and the curve of counter E. M. F. developed by the secondary current is $\frac{3}{4}$ of a period behind the primary E. M. F.

We are now prepared to understand why the counter E. M. F. developed in the induction coil varies in its counter effect as current is abstracted from the coil. The reason is simply that its position of counter effect is dependent on the curve of its producing current, and as the current occupies a variable position relative to the applied E. M. F., the counter E. M. F. successively occupies positions of lesser counter effect until eventually it has no counter effect whatever.

These phenomena are taken advantage of in the operation of induction coils. If a constant E. M. F. be applied to the primary circuit of a converter, successive increments of current will be allowed to occupy this primary circuit, as successive quantities of current are abstracted from the secondary circuit; because these currents push along out of the way the opposing counter E. M. F., and consequently the kinetic E. M. F. attains correspondingly greater values.

Thus far we have considered only two factors of self-induction and retardation, viz., the number of turns of the conductor, and the quantity of current flowing; but there is another factor, most important, and that is, the resistance of the magnetic circuit.

The magnetic resistance of iron is, as you know, similar to the resistance of any other conductor, in that it is directly proportional to the length, and inversely proportional to the sectional area of the circuit. This, however, is only true for limited values. As the magnetic lines traverse a core they encounter a resistance proportional to their number at first; but if more lines be continuously added, a number is eventually reached which the iron utterly refuses to carry. This degree of magnetism is termed "saturation."

It can be shown that the position of the curve of counter E. M. F. is directly connected with the degree of saturation of the core, so that with a given coil the position of no counter effect of the counter E. M. F. coincides with saturation of the core. The magnetic resistance of the core of an induction coil determines, then, the limit of retardation or lag of the current phase. Hence, if we wish to construct a coil in which the counter E. M. F. shall always be inversely proportional, and the kinetic, applied E. M. F., always directly proportional to the current abstracted from it, we make the core of the coil with the lowest possible magnetic resistance. Such a coil, when supplied with a constant difference of potential, will furnish at its secondary terminals an approximately constant E. M. F. It is also evident that a coil having a limited section of core supplied with a constant current may deliver a constant E. M. F. on its secondary terminals, provided the field produced by the constant current is sufficient to saturate the core.

I noticed these phenomena several years ago when experimenting with a series system for lighting. Mr. O. B. Shallenberger has applied this saturation effect in a most striking manner. He connects a number of incandescent lamps, say four, in series, attaching their outer terminals to a source of constant alternating E. M. F. Around each lamp is shunted a self-induction coil, so proportioned that an E. M. F. of say 100 volts will saturate the core of the coil. If, now, a lamp be turned off, its current is diverted

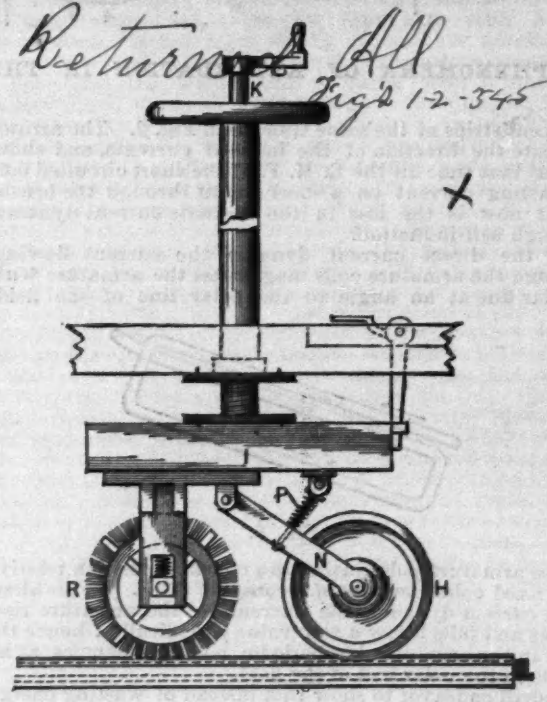


FIG. 3.

through the shunted coil, which offers a counter E. M. F. of 100 volts. We would naturally expect that the light in the remaining lamps would grow dim, but this is not the case. If we measure the difference of potential on the extreme terminals of the lamps we find it to be 200 volts; on the three burning lamps it is 50 volts each, while on the shunted coil it is 100 volts; so that the sum of the potentials of the three lamps and the coil is 250 volts, while the applied E. M. F. is but 200 volts.

I think the explanation of this is as follows: During the first part of the rise of the E. M. F. wave, the shunt coil practically offers an infinite counter E. M. F., in comparison with which the resistance of the lamp may be neglected; when, however, the applied E. M. F. has attained a value of 100 volts, this counter E. M. F. is surmounted, because the core of the coil is saturated by the current flowing in the coil.

The lamps, therefore, receive the remaining 100 of the 200 volts applied, since the coil, being saturated, offers no additional counter effect. Now, after the wave of E. M. F. has declined to a value less than 100 volts, the stored magnetism in the core of the shunted coil begins to lose strength, and in so doing, develops an additional E. M. F., which, assisting the generator current, furnishes a current during the time the applied E. M. F. is of low, or zero, value, and by so doing keeps the average E. M. F. on the lamps constant.

It is necessary then, in working with alternate currents, to take into consideration the time retardation or lag of the current behind the E. M. F. We have seen that this lag is dependent on the resistance of the core, and on its degree of magnetization. I have found it especially necessary to make time corrections in work on alternate current motors, and in apparatus depending on the attraction or repulsion of magnets energized by alternate currents.

I have stated that there is no loss due to the periodic magnetization of iron cores by an alternating current. This is only true of a perfectly subdivided core. A solid core allows secondary currents to flow. Hence its storage capacity is lowered. In practice, the loss due to wasted currents in laminated cores can be kept as low as one per cent.

We may summarize the effects of the retardation of currents behind the E. M. F's. in the induction coil as follows:

Retardation causes the counter E. M. F. developed to have counter values inversely as the quantity of current flowing in the coil.

Retardation causes the energy expended in magnetization during the increase or development of a current to be returned as current energy during the subsidence of the current.

To an alternating or similar current, iron offers true storage capacity for all values of magnetization below the saturation limit.

Irish's Electric Railway System.

While it is acknowledged that, other things being equal, a conduit for the conductors is better adapted to heavy city traffic than an overhead system of conductors, there

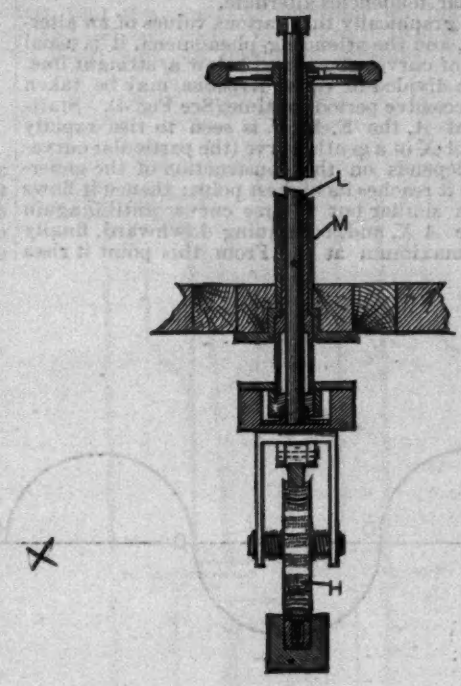


FIG. 4.

are still some who object to the slot running along the street and indeed more than one attempt has been made in the past to avoid the use of the slot and to establish connection with underground conductors by other means.

In attempting to solve this problem, Mr. W. E. Irish, of Cleveland, Ohio, hit upon the idea that if a conductor could be inclosed into an elastic conduit, a car passing above it might, by pressure, make a contact with the conductor within and thus establish a connection; and this connection, made directly under the moving car, would be immediately broken when the car had passed on, this action being due to the elasticity of the conduit.

The manner in which this has been carried out is shown in the accompanying illustrations. Here Figs. 1 and 2 represent the arrangement adopted by Mr. Irish, in section and perspective. As will be seen, *A* represents an elastic or yielding conduit of soft rubber, which will yield to the pressure of the contact wheel and react with sufficient force to clear the conducting wire when the pressure is removed.

The tube or conduit is closely sealed throughout its length so as to exclude water or moisture and to prevent metallic contact at any point except through the proper connections. A channel for carrying the tube is formed in a line of timbers or blocks of stone *B*, the channel being shown as having flat parallel sides and an open top. The timbers or blocks carrying the tube are laid

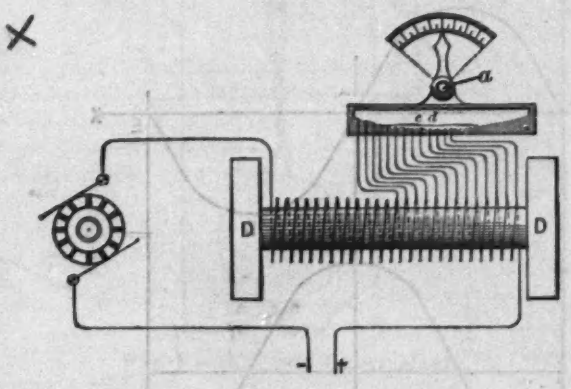


FIG. 5.

along the rail-post track, between the rails, flush with the surface of the roadway, two lines being used, one to carry the outgoing conductor and the other the return conductor.

The tubes *A* carry the line wires or conductors *C* at the bottom of the oblong track therein. These conductors are uncovered and uninsulated except as to the rubber tube *A*, which forms a covering and insulation, so that contact may be made within the tube at any point in their length. Attached to the tube along its upper surface are short rail pieces *D*, having small flanges *d* at their sides, which rest on shoulders on the tube, and when in their normal position are flush with the roadway and top of the timbers.

Inside of the tube *A* and corresponding to the rail pieces *D* in length are contact pieces *E*, flanged laterally at the top, and having a central portion *e* which rests in the tube above the line wire or conductor *C*, and normally out of contact therewith. The rail and contact pieces are insulated from each other by the rubber tube except where

they are connected by screws, by which they are firmly united. The short rails and inside pieces are arranged in pairs, and the pairs are insulated from each other by having a sufficient space between them at the ends. This will allow one section or pair to be depressed without interfering materially with the next on either side, the rubber to which they are secured being sufficiently flexible for this purpose.

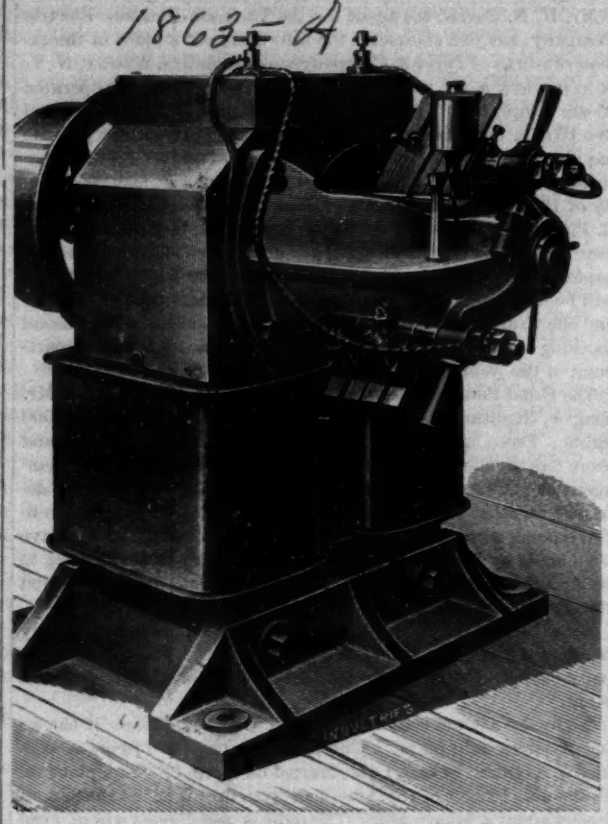
In Figs. 3 and 4 *H* represents the contact wheels, similar in construction, one of which is attached to either side of the centre of the car and electrically connected with the motor upon the same. The wheels are each pivoted on a frame or turn-table *I*, which is arranged to be reversed upon the car according to the direction the car is to travel and to be raised or lowered according as the wheel is to be thrown into, or out of, contact with the track. Figs. 3 and 4 show the mechanism by which the several movements are effected. Thus the position of the table *I* and its attachments is reversed by means of a rod *K* rigidly fixed thereto and having a crank lever at the top, and it is raised and lowered by means of the tube *L*, which has a hand wheel *l* and works inside the sleeve standard which supports the parts of the platform on the car.

The contact wheel *H* is hung in a pivoted frame *N* on a shaft on which it has some lateral play to adapt it to travel on a track that may be somewhat out of alignment, and the wheel has a concave tread which enables it more certainly to keep the track. *P* is a tension spring bearing upon the wheel frame *N* with such pressure that, as the wheel passes over the sectional track, it will depress the sections successively so as to bring the inside pieces *E* in contact with the main wire within the tube. The wheels *H* act alike in this particular. The moment a wheel depresses a section sufficiently, the circuit is closed through that section; the screws connecting the short rails and the inside contact pieces being the medium for the passage of the current through the rubber tube; and as one section is not cleared before connection is established through the next succeeding section by the wheel passing from one section to another, the flow of the current is made continuous while the contact wheel is down. When the sections have been passed by the contact wheel, the elasticity of the rubber carries them successively back to their original position.

The conductors in the bottom of the rubber tube are coupled together in sections in suitable lengths by means of a variable expansion joint which will allow of expansion and contraction under varying temperature without, to any appreciable degree, altering or affecting the electrical resistance. One satisfactory way of doing this is by placing a sleeve over the ends of the conductor where they meet, inside of which is a spiral spring which bears against the ends of the conductor. This spring is compressed by the expansion of the conductor and elongated when the conductor is contracted, but always makes effective contact with the conductor and with the sleeve. The sleeves have about the same resistance as the conductor, but the contact between the sleeves and conductor, or line wire, is more or less imperfect, and this imperfect contact is made up for by the springs.

In front of the contact wheel is a combined brush and scraper *R*, supported upon the same frame with the contact wheel and designed to run in front of it and clear the exposed section surface rail of dirt, snow and other obstructions, so that perfect contact may be made with the rail or track. Connected with the conduit described above and beneath the same is a second conduit *V*, Fig. 1, of cylindrical form, with a V-shaped opening longitudinally in its top and having lateral flanges by which it is bolted to the timbers or blocks carrying the first-named conduit. The conduit *V* is designed to carry telegraph, telephone, electric light, and other wires, and has a V-shaped covering *W* underlaid by a sheet of packing of soft rubber, which extends laterally over the flanges and upper conduit timbers. By unscrewing the top, the wires can be reached at any point, and the tube can again be perfectly sealed by screwing the top into position.

One of the methods of automatic regulation devised by Mr. Irish is shown in Fig. 5. This consists of a tube having a concave longitudinal section, and a pivot on which it may be adjusted to give it any desired inclination. As shown, the tube is resting in a horrizontal plane, and



THE NEW PHŒNIX DYNAMO.

this throws the mercury contained in the tube into the centre. The series of wires *cd* extend into the tube and make connection with the corresponding coils on the field magnets of a motor *D*. When the mercury lies as shown in Fig. 5 all the coils on the motor whose wires *cd* are covered by the mercury are cut out, and only those are energized whose wires are not so covered and connected. The charging of the field magnets and the amount of electrical energy therein is therefore under convenient and easy control through the tube. Obviously, if the tube be tilted to the left it would convey the mercury forward and thus make connection with one set of contact points after another, until at last, if carried far enough, the entire field would be cut out and the motor would stop. On the other hand, the entire energy of the current may be thrown into the motor by making the extreme adjustment to the right, and relieving the contact points of the connecting fluid.

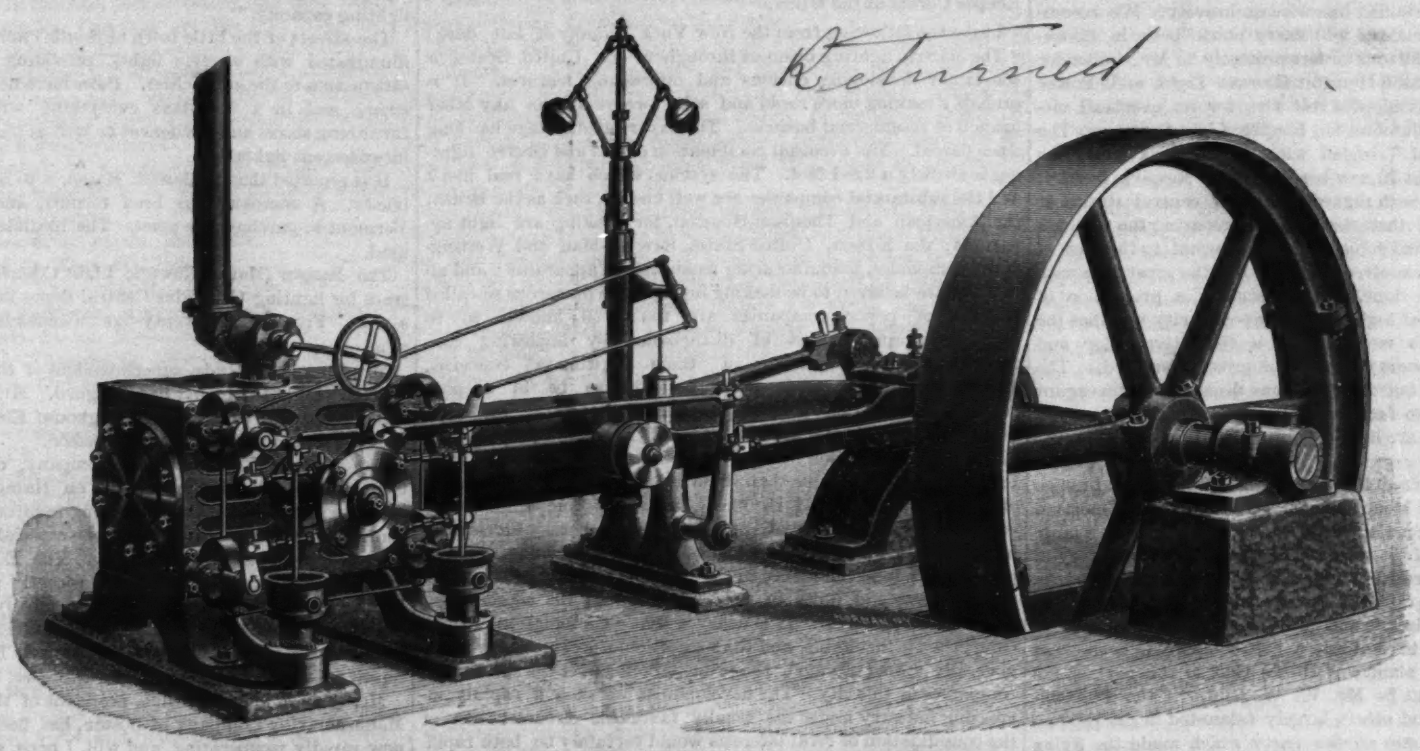
The motor employed by Mr. Irish is very flat and of novel design. It is supported under the car body between the wheels, and is so arranged that all or any part may be examined, oiled, or replaced from the inside as well as the outside of the car in a few minutes. The motor shaft is furnished with two armature coils and two driving wheels, the latter being on each end of the shaft. The maximum power is obtained when both the fields and the armature coils are active, although the car can be run with one field and both armature coils, and also with both fields and one armature coil, or with one armature and one field active.

The "Eclipse" Corliss Engine at the Electrical Exhibition.

At the late American Institute Exhibition a large part of the electrical exhibits which required power were driven by an "Eclipse" Corliss engine of 125 h. p., built by Messrs. E. P. Hampson & Co., of this city. The valves of this engine, which is shown in the accompanying illustration, are designed to take up their own wear, and act as relief valves under certain conditions.

The piston has an improved light spring packing, with narrow self-acting packing ring, the whole weight of the piston resting upon a broad and solid junk wearing ring, adjusting screws being provided so that the piston can be maintained exactly in the centre of the cylinder. The whole can be readily taken apart for examination. This piston, it is claimed, does not wear the cylinder out of round, and while it is always steam tight, moves with the least friction.

The engine ran with the greatest smoothness, and regulated very well, as was shown by the steadiness of the lights, both arc and incandescent, which derived their power from it.



THE "ECLIPSE" CORLISS ENGINE AT THE ELECTRICAL EXHIBITION.

The New Phœnix Dynamo.

The present tendency as regards the construction of field magnets for dynamo machines, says *Industries*, seems to be in favor of the single horseshoe type. Several makers, who began by designing double horseshoe machines, have given up their original pattern, and are using single horseshoe magnets, which have the advantage of requiring less exciting energy, and giving therefore a slightly increased efficiency. In addition to this advantage, the amount of wire on the field is also reduced, and the cost of production slightly less, as compared with the other type; but they have the drawback of being rather heavier than double horseshoe machines. With a view to reduce the weight and secure some other advantages, Messrs. Paterson & Cooper have lately made a new type of their Phœnix machine, which is illustrated in the annexed engraving. The magnetic system consists of a single horseshoe in one solid forging, by which means the magnetic resistance of joints is avoided. In order to reduce the weight, the usual bed plate and standards for the support of bearings have been omitted, the bearings being placed in gun metal bridge pieces, bolted to the polar extensions of the magnet limbs as shown. To secure sufficient stability, two cast-iron angle brackets are bolted to the yoke of the magnet, and these are provided with holes for the foundation bolts.

The machine is designed for an output of 100 ampères at 250 volts pressure when driven at 700 revolutions per minute. The total weight is 28 cwt., being at the rate of 1 pound of material for every 8 watts developed in the external circuit. The following are some of the constructive data of the machine: External diameter of armature core, 13¾ inches; internal diameter of armature core, 8 inches; length of armature core, 12 inches; cross section of magnets, 12 inches by 8 inches: net sectional area of iron in armature, allowing for insulation, 30 square inches; sectional area of iron in field, allowing for rounded corners, 95 square inches; diameter of polar cavity, 15 inches. The armature is wound with 360 turns of .150-inch square wire in two layers. The field is shunt wound, each link containing 3,540 turns of .062 inch

wire, and the total resistance is 83 ohms. The radiating surface of both magnet limbs is 1,200 square inches, and the energy used up in exciting is 750 watts, the ratio of cooling surface being, therefore, 1.6 square inch per watt. The internal electromotive force is 258 volts, and with a shunt current of about 3 amperes the electrical efficiency is $\frac{250 \times 100}{258 \times 103} = 94$ per cent.

From the above data we find that the total intensity of the field is about 6,200,000 c.g.s. units, that the useful induction through the armature is 16,000, and the induction through the field 10,100 lines per square centimetre. The peripheral speed of the armature core is 2,530 feet per minute, and the total length of conductor wound on the armature is 11,200 inches, being at the rate of 45 inches per volt in the external circuit. For purposes of comparison, it is convenient to state the output of the machine for a peripheral speed of 3,000 feet, which is a fair average in modern belt-driven dynamos, and on this basis we find that 38 inches of armature conductor produce 1 volt, while the weight of the machine comes out at about 80 pounds per horse-power, in the external circuit, which must be considered an exceedingly good performance.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
NEW YORK, Dec. 12, 1887.

The telephone investigation has been resumed at the Coal and Iron Exchange building, in Cortlandt street. The work of the committee has been confined to an examination into the affairs of the New York & New Jersey Telephone Company and the Metropolitan Telephone Company. Several well-known gentlemen have been on the witness stand, including President Cutler, President T. N. Vail, General Huidekooper, Auditor Guerry and others. The whole history of the development of the two companies has been gone into. Mr. Vail gave the committee some interesting information as to items of outlay, which may well be taken to offset any large gains the business may show from time to time, and he called the attention of the committee to such expenses as that involved in the big new switch-board, whose actual cost before they get through will be about $300,000, and that connected with the subway work, the actual cost of which is still uncertain, but will no doubt be enormously heavy. Mr. Vail expressed himself as in favor of the toll system, as against the flat rate. It was shown that the Metropolitan Company had paid out in dividends from 1883 the sum of $745,000. As is well known, the Metropolitan is one of the most profitable exchanges in the country, Chicago being that which perhaps comes nearest to it.

I had an interesting talk with Mr. W. M. Callender, of the Callender Insulating and Water-proofing Company, this week. He informs me that the Thomson-Houston Electric Company have made special arrangements with them so that it can offer to its sub-companies the new Trinidad line wire. The Thomson-Houston Company says in a circular on the subject: "We consider this wire to be the best line wire on the market, and in proof thereof have decided to equip both our New York stations, now in course of construction, with Trinidad line wire exclusively. We recommend it to all our patrons, and will carry stock both in Boston and Chicago, so as to fill our orders promptly." Mr. Callender tells me that the Thomson-Houston Electric Light and Power Company of Buffalo has adopted this wire for its overhead circuits, as has also the Columbus, O., Electric Light Company. The demand for Bitite and Trinidad wires is so brisk that the company has had to put 70 new braiders in its Newark factory. Mr. Callender tells me with regard to the new central station at Leamington, England, that the cost of preparing the trenches there for the underground cables put in was equal to the cost of the Callender cables themselves. This shows the great care with which the work was done. In this country a proportion of 20 per cent. is considered high. Another peculiarity was that the cables of each circuit were painted a distinctive color and varnished, some blue, some yellow, some green, some red. The effect was very pretty, but the idea seems decidedly extravagant and useless. In order to facilitate running at night time, Mr. Callender has put a 20 arc light Thomson-Houston plant in the works.

I take the following from the New York *Tribune:* "I notice that the little suburb of Mount Vernon has awarded the American Electric Manufacturing Company the contract to light a large portion of the streets of the town. The company has a factory in the town and could probably underbid any rival for that reason alone; but it shows its faith in the theory of its President, Edwards H. Goff, that electric and gas lighting are allied, not rival interests by proposing to establish a gas company in connection with the electric light plant. With Mr. Goff in this part of the scheme there is said to be Mr. W. W. Gibbs, of the Philadelphia Gas Syndicate and others largely interested in gas production. Mr. Goff was one of the party which made the flying trip to Albany on the new vestibule train of the Central Railroad. He went in a triple capacity, and for pleasure chiefly, though he had an eye for business. His brain is busy with the idea of lighting trains of cars by electricity in connection with a system of steam heating. Such a combination he believes would make trains absolutely free from danger from fire. Mr. Goff went also as a politician, and as such lunched at the Executive Mansion with Governor Hill. He went also as a newly fledged publisher, having recently purchased *The Graphic* of this city. The paper has greatly improved of late. Colonel Frank A. Burr is now the editor; Louis N. Megargee is temporarily acting as managing editor; Mr. George Wotherspoon has become the musical and William F. G. Shanks the dramatic editor."

I had the pleasure last week of inspecting the line of electrical supplies made by the V. Prentis Electric Manufacturing Company, who have lately located their salesrooms at 45 Dey street, with their factory at 170, 172 Centre street. Mr. Prentis pointed out to me, among other things, the principal features of their bells. They are first-class, nickel finished throughout, and have the armature core held by a finely adjustable spring, fastened to an adjustable post, so that the armature can be employed with any number of batteries, giving either a heavy or a light ring as desired. The push buttons are also new and well made. The company make, in addition, the "Red Letter" Disque Leclanché battery, as well as a complete line of handsome wooden box and skeleton bells, buzzers, push buttons in wood, switches, door openers, springs, etc.

I am glad to note that Mr. W. Noll and Mr. E. T. Greenfield, old Edison wiring contractors, have lately associated themselves to contract for wiring for the Edison system. They have pitched their headquarters at 15 East Sixteenth street, where they will always be ready to undertake first-class work in incandescent wiring.

Mr. H. N. Curtis, the agent for the Thomson-Houston Electric Company, has just completed the installation of a plant in the extensive works of Perry & Company, stove founders, Albany, N. Y. It comprises a 50 arc light dynamo, from which are operated 25 arc lamps, five 32 c. p. series incandescents and a hundred and five 16 c. p. incandescents, of the individual distributor type. He has also just taken a contract for one 30 and one 50 light arc machines for the New Rochelle Company, giving that plant a capacity of 130 arcs and 400 incandescents. In connection with Mr. S. L. Phillips, the agent for northern New York, he has effected the consolidation of the Gloversville and Johnstown electric light companies, securing a valuable water-power, from which both towns will be lighted. The plant consists at the present time of two 35 and one 45 arc light dynamos. Mr. Curtis has also put in a second focusing lamp for photographing purposes in the work department of the *New York World*.

The Hotel Ponce de Leon, at St. Augustine, Fla., built by Mr. Flagler, the Standard oil magnate, has an Edison plant of 2,000 lights. These lights are run by three 600 light dynamos, and room has been left for another machine of same size. The management places entire confidence in electric lighting, and has debarred all other illuminants. Special fixtures of rich design to correspond with the architectural and decorative details have been made by Bergmann & Company. Not only is the building to be lighted but lamps will be distributed along the exterior and throughout the alcazar.

Some idea of the extent of work required on mere details may be formed from the fact that a leading New York glass company supplied 400 dozen shades of special design for this plant.

No insane asylum is now considered complete unless it has an incandescent light plant. The Edison plant of 900 lights at Willard's Asylum, Seneca Lake, started on Dec. 4. The plant includes also 10 arcs of the American system. The establishment covers about a square mile. The light is used everywhere, even for effects on the stage, where the inmates indulge in harmless performances. The plant is run on the three-wire system, with feeders to each building, of which there are 10 in all. A recent letter from the management says that the plant is most satisfactory, and that 50 per cent. more light is enjoyed than was anticipated. The 900-light plant at the Utica Asylum will be completed by Jan. 1. The Edison plant at the Ohio State Asylum, Toledo, went into operation on Dec. 8. This asylum is laid out on what is called the cottage plan, the buildings being disposed along the sides of the square, and the administrative offices across the centre. This plant includes 1,800 lights, operated by 4 dynamos and 3 Straight Line engines. At Willard's Asylum Armington & Sims engines are used, and E. P. Hampson & Company's new Eclipse Corliss at the Utica.

I take the following from the New York *Tribune* of late date: "The electric lighting business throughout the United States is constantly developing curious and interesting features. It is probably making more rapid and solid progress than any other branch of commercial business. The experimental stage has long since passed. The eventual combination of gas and electric lighting is already a fixed fact. The systems which have real merit and the substantial companies are well known, such as the Brush, the American and Thomson-Houston, for making arc light apparatus; the Edison, United States, Sawyer-Man and Westinghouse companies, manufacturing incandescent apparatus; and all of these are believed to be making money. The numerous so-called systems of paper companies are too well known to be any longer an element of disturbance by impairing confidence in the business of these legitimate concerns. The companies named may be said to be in a position to control the electric light business of the world, for there are no large companies abroad. There is no reason why combination should not soon make their manufacturing interests more important and profitable than those of the textile manufacturers of the United States. If the really important companies would stop the slang and abuse of each other in which they incessantly indulge to their own detriment only, and the sacrifice of some part of the public confidence in the financial solidity of the electric business, and unite in the proper spirit, the combination would be all powerful. It is believed that a combination of these enterprises is inevitable, and the suggestion of union is now being generally talked of among the principal officers of the substantial companies in this city. The development of such a rapidly increasing industry under the usually favorable circumstances of the consolidation of rival interests would certainly be both rapid and extensive."

The E. S. Greeley & Company, of 5 and 7 Dey street, are the agents of the standard electrical testing apparatus made by the Electric Manufacturing Company. These instruments are of the best possible material and construction, and are creditable specimens of American ingenuity in this field. They have been very favorably criticised by many leading electricians and scientists in this country. The standard set of resistance coils was tested at Johns Hopkins University by Dr. Duncan. Their condensers are adjusted by comparison with a standard condenser whose value has been determined in absolute measure. The products of the company include galvanometers of various types, resistance coils, keys, switches, condensers, commutators, etc., embracing all that is necessary for delicate and accurate work. The company make also the ingenious Bailey testing set, which consists of a 3-coil tangent galvanometer, a rheostat and a combination key, with 13 coils in the rheostat, giving 1443½ ohms in the aggregate, and ranging from ¼ ohm to 700 ohms. Another instrument is the Pratt patented speed indicator, for which several special points of excellence are claimed. These goods make an appropriate addition to the large stock of the Greeley Company, and should be seen by all who intend investing in this line.

Mr. J. F. Kelly, agent for the Edison Machine Works wire insulating department, took an order last week for $11,000 worth of magnet wire, and incandescent cord. The order included 85,000 yds. of cord. This is the largest order of the kind ever placed, I am safe in saying, and I should very much like to know, as a matter of curiosity, how it is all disposed of. When it is remembered that this cord is rarely used in lengths greater than two or three yards, some idea may be formed of the enormous development of incandescent lighting.

An indication of the effect of the recent fluctuations in the metal market has been given in the recent actions of wire manufacturers and others. I have now before me a card just issued by the Standard Underground Cable Company, stating that owing to the advance in the price of ingot copper, copper wire and lead, it has withdrawn all the old quotations on its lead covered cable and insulated wire. New prices can be had on application at its offices in Pittsburgh, New York and Chicago.

In connection with the Brotherhood engine, illustrated and described in your last issue, I may mention that it is now made by the Chester Foundry and Machine Company, Chester, Pa. Mr. Alfred Brotherhood represents the engine in this country, having his office at 111 Liberty street, the salesrooms of Manning, Maxwell & Moore. Besides being used in storage plants, these engines are becoming generally known in a variety of industries. The United States Government has taken nearly 30, ordered inside of the present year. All information desired on the subject of this engine can be obtained from Mr. Brotherhood.

The Stratton separator, which was noticed recently in your columns, has received a medal of superiority from the American Institute for separating water from steam, and for conveying entirely dry steam to an engine, thus doing away with all water in engine cylinders, a feature very advantageous for high-speed engines.

W. T. H.

ILION, N. Y., Dec. 1, 1887.

The Signal and Pyrotechnic Electric Light Company is the purchaser of four patents issued to A. C. Ferguson, of Saratoga Springs, N. Y., and it proposes to manufacture, as soon as things are in shape for so doing, all kinds of electric signals, by letters, figures and words, and all kinds of signs for advertising purposes, signs for stores, etc. It intends also to make pyrotechnic pieces, designed to supplant the present costly system of fireworks. The devices covered by the patents embrace an immense field. The company claims to have an arrangement which will be a great improvement in the disposition of letters, etc., as well as an extremely attractive and cheap system of advertising by electric light signs. The officers of the company are: President, A. C. Ferguson, Saratoga; first vice-president, W. Baker; secretary, M. G. O'Brien; treasurer, C. C. Smith; superintendent, W. F. Bossert, all of Ilion.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Dec. 12, 1887.

Advices from Rutland, Vt., say: "The electric light station in this town is to be enlarged and the arc and incandescent light equipments will be increased to more than double the present lighting capacity."

The streets of the little town of South Paris, Me., will soon be illuminated with electric lights, providing the trial lights give satisfaction to the authorities. Poles have been erected and wires strung, and in a few days everything will be in readiness for furnishing stores and residences as well as the streets with arc or incandescent lights.

It is reported that Hallowell, Maine, is to be lighted with electricity. A company has been formed, and an agent sent to Vermont to purchase the poles. The incandescent system will be used.

The Bangor (Maine) Electric Light Company has closed a contract for lighting the Maine Central depot in this city, at $1,000 a year. Five arc and twenty-five incandescent lights will be put in at once.

Mr. Jerome W. Hyde, superintendent of the Springfield, Mass., Electric Light Company, has resigned. Mr. A. P. Wright, formerly connected with the Westinghouse Electric Company, has been appointed as Mr. Hyde's successor.

The Eastern Electric Cable Company, of Boston, seriously contemplates enlarging its factory on Hampshire street, and increasing its force and manufacturing facilities. Demand for this company's wire and cable product—especially from the electric light people—is steadily increasing. The Edison United Manufacturing Company, of New York, recently gave an order to Mr. H. H. Eustis (of the first-named company) for an enormous quantity of cable ("Clark" standard, and 341 Edison gauge), the same as placed in the Court street tunnel, Boston, recently, referred to in THE ELECTRICAL WORLD, Dec. 3.

Mr. Leopold Schlegelmilch, president of the Schaefer Electric Manufacturing Company of Boston, has been quite ill; but he is now rapidly recuperating, and will, I hope, soon again be able to get around among his friends. The lamps manufactured by the Schaefer Company are in demand throughout the country, and give satisfaction wherever used. As stated once before in my notes the company is devoting its manufacturing facilities exclusively to the making of the Schaefer incandescent lamp.

The following item is taken from a Brattleboro (Vt.) exchange: An important and significant move during the past week has been the purchase of the Thomson-Houston electric light plant now in use here by the association of men who bought the tannery property for use as an electric light station, with the water of Whetstone Brook for motive power. The trade was concluded last Saturday with Mr. Wing, the Brattleboro representative of the company. It is not announced when the Brattleboro concern will take possession, and the terms of the sale are not given. Probably the price paid was not an extravagant one, for the station and plant have been cheaply constructed. The Brattleboro concern will not attempt to erect its water-power station on the brook this season, but they state positively that a dam will be built and the plant removed there as soon as spring opens. They will undoubtedly put in a compound condensing engine in the present station, for use during the winter, and to be removed in due time to the

water-power station to help out when the supply of water is low in summer. Its system will include both the arc and the incandescent lights.

The Sprague Electric Railway and Motor Company through its New England agents, Messrs. Sawyer & Blake, is devoting considerable time to the installation of motors for running elevators. Among the recent purchasers of motors in Boston for the purpose named are: Mr. Henry A. Whitney, 54 Boylston street; Mr. Nathaniel H. Emmons, 25 Temple place, Mr. J. N. Fiske, 31 South street; Messrs. Batchelder & Lincoln, 96 Federal street, and the Carter Rice Company, 246 Devonshire street. At the last named place two heavy elevators are operated by one motor; and at 96 Federal street three elevators derive their power from one large motor.

Satisfaction is expressed at the constancy of speed and the reliability of the service in the use of electric power, and the Sprague Company is to be congratulated on the success it has made in this difficult service.

The first annual election of officers of the Boston Electric Club was held last evening at No. 66 Boylston street. The following were unanimously elected: President, P. H. Alexander; vice-presidents, William J. Denver, Suel Smith, E. Wilbur Rice, Jr., Frank Fuller; treasurer, F. J. Boynton; secretary, Robert F. Ross; historian, Allan V. Garratt; executive committee, Frank Ridlon, A. H. Chapman, C. M. Ransom, H. B. Cram, H. J. Pettengill, Edward Blake, Leopold Schlegelmilch, William Brophy, A. L. Rohrer, George W. Adams, Henry B. Lytle, J. T. Moriarty, S. E. Barton, W. I. Barker, George W. Davenport, H. H. Eustis, H. N. Sweet, E. L. Caldwell, F. E. Clark, J. R. Lovejoy. Brief remarks were made by several of the officers. The annual meeting will be held next Thursday evening, and the annual dinner on Dec. 17. On Monday evening, Dec. 19, Prof. A. E. Dolbear will lecture before the club.

A recent number of the *Graphic* contained the following item: An interesting manual upon the "Commercial Development of Electric Lighting in this Country" has recently been issued by the Maverick National Bank, of Boston, of which Mr. Asa P. Potter is president. The book is interesting and instructive reading for some of the eminent bankers and financiers of the United States, who from their lamentable ignorance of the subject have improved every opportunity to discredit electric lighting as a legitimate business enterprise. Mr. Potter is one of the most progressive and successful bankers in this country, and his opinion upon this or any other financial subject is worthy of the most respectful consideration.

The New England Wiring and Construction Company's business has increased to such dimensions that it has been found necessary to enlarge its manufacturing department and employ more men. To this end the company has leased extensive premises at No. 11 Bowker street, Boston, and a considerable quantity of the latest improved machinery has been purchased and will soon be placed in position. By Jan. 1 the working force will number over 100 employés. Before the beginning of the new year the company will be enabled to handle and dispose promptly of orders for its "Regulator" oil cups, its new multiple switch system, as well as apparatus and supplies of all kinds required in its work. Referring to the company's wiring and construction department, it is proper to say that this branch is constantly kept busy by orders from local electric light companies, for both arc and incandescent work.

Among the contracts in this line just closed by the New England Wiring and Construction Company are the following: The arc-light plant of 75 lights of the American system at Hyde Park, Mass.: a central station of 500 or more Edison incandescent lights at Claremont, Vt., and a small central station at Newport, R. I., using Edison incandescent lights from accumulators, the latter being charged by Edison dynamos.

Messrs. Claflin & Kimball, N. E. agents for the Mather Electric Company, report the installation of Mather plants on which their men are at work, as follows:

State Alms House, Tewksbury, Mass., 500 lights.
Rumsey Bros., Mansfield, Mass., 300 lights.
Forest Paper Company, Yarmouth, Me., 225 lights.
Norton Emery Wheel Company, Worcester, Mass., 75 lights.
Bunker Hill Cyclorama, Boston, Mass., 50 lights.

The Boston *Evening Transcript*, Dec. 9, thus describes the trial trip of a West End street car, equipped with a new motor:

A fresh method of drawing electric power from the Julien storage battery and offering it to practical work on street cars was exemplified to-day on a disused car of the old Cambridge Railway. The method is that of Colonel E. H. Hewins, general superintendent of the Weston New England Electric Light Company, and so far as its working upon an improvised car was concerned its accomplishment was admirable. What the device would attain in excess of power on a new car designed for this especial duty it is difficult now to compute. The car was announced to pass the *Transcript* building at noon to-day, and notwithstanding the difficulties of soft mud on the rails, reached that point, having made the trip from Cambridge within a minute or two of the hour set. But there is nothing like sand, which the projectors, of all others, well know; and in the absence of sand boxes on the part of the old car, they detailed several Cambridge trackmen, who were cognizant of where the gravelly substance could be procured on the route, and ventured the journey in the face of drawbacks. The Cambridge and the bridge tracks, having the advantage of the forenoon's sun, were dry, and the trip to Boston was quickly made. Upon reaching the city proper, however, the need of a frequent application of this traction assister was quickly apparent, and the men lavishly bestowed it upon the rails. With this liberal application in front of the car, Cambridge street hill was easily ascended, the motor working smoothly, without jar or whirr, passing over the customary West End route, over Court street, Cornhill, and Washington street to Milk, where the sand gave out, and the Cambridge trackmen were at a loss where to find a fresh supply. It was finally obtained on the site of the old Milliken House in Ordway place, where building operations are going on, and the car triumphantly proceeded around the curve into Temple place, through Tremont and Boylston streets, around the Park-square route of the Cambridge Railway, by the Providence passenger station. The greatest speed in the city was attained between the Common and Public Garden on Charles street. It was not so rapid as that of a pair of horses urged, but would have undoubtedly been greater but for the interruption of heavily loaded wagons, which, to the credit of their drivers be it said, were as promptly as possible steered out of the way. The Boston passengers, chiefly newspaper men, left the car as it entered upon the return trip over the bridge to Cambridge. The Weston motor varies from the Sprague motor, tested on a similar car several weeks ago, in that it has a different method, as before said, of taking the electricity from the battery under the seats, which is composed of twenty cells. There is only a single motor or dynamo, taking up little space under the flooring, working upon a shaft whose revolutionary power is applied to a pulley on the aft axle by means of six steel belts instead of cogs. The pulleys are about twenty-two inches in diameter, and their operation is noiseless. There is not even the rattling noise of the ordinary horse cars. Two sets of batteries will be required to operate a car each day, ten hours being required to charge each. The number of miles actually to be run by them, regardless of stops, has not yet been determined by Colonel Hewins. All on board were highly interested in the movement of the motor and the car, and expressed their pleasure at having been invited to the little trip.

Mr. John T. Moriarty, of Boston, the New England agent of the New York Accumulator Company, recently equipped the large factory of Messrs. Reed & Barton, at Taunton, Mass., with a set of storage batteries to be used for electroplating purposes. A letter has been received by Mr. Moriarty from the above named firm, in which was set forth a report of the satisfactory results arising from the use of the storage batteries furnished by him in connection with electroplating work of various forms.

Mr. B. T. Burt, special Central American Agent for the Thomson-Houston International Electric Company, has just arrived in Boston from Guatemala after an absence from the "Hub" of several months. Mr. Burt says that he enjoyed excellent health while in the tropics, and that he admires the country and people of Guatemala. He reports business of that country as being in a flourishing condition.

Mr. C. C. Curtiss, of Cleveland, O., the general agent of the Brush Electric Company for the States of Ohio and Indiana, was in Boston during the past week.

Mr. Theodore Pinkham, Boston, has secured the New England agency for the productions of the Union Indurated Fibre Company.

The Chadwick Lead Works, Boston, is inviting the attention of electric light, telegraph and telephone companies, and wire and cable manufacturers, to its patented processes of covering with lead all sizes of wires and cables for aerial or underground use. This company states that it can put on a heavy or light covering, as desired, and by fine adjustment have the same tight or loose, as may be required, and can cover the most delicate insulation without the slightest injury to the insulating material.

The Chadwick Company's new building on Fort Hill Square is nearly finished and the company expect to occupy it early in January.

The large steam pumps which the George F. Blake Manufacturing Company of Boston is at work upon at its factory in Warren, are being pushed forward night and day for the city waterworks at Cleveland, Ohio. The pump is 32 feet high to tip of air chamber, and a man 5 feet 10 inches high can walk through the cylinder. A building has been erected at the works in which to set it up, and many visitors from out of town have been in to see it. It is a wonderful piece of mechanism, and its fine proportions are admired. This company is selling a large number of its pumps to electric light stations and plants.

The Riley Elevated Railway Company of Boston, represented by Messrs. F. A. Bartholomew and others, has petitioned the Massachusetts Legislature for a charter. The company propose to operate a belt line elevated road taking in the principal railway stations together with radial lines to a number of the suburbs. In its petition the company specify that they intend to use electricity as a motive power.

The Gould Packing Company of East Cambridge, Mass., is enjoying a large patronage from the electric light people throughout New England; and, in good time, I predict, the Gould packing will find its way into all sections of the country where steam engines and steam and ammonia pumps are used. The Boston *Commercial Bulletin* in a recent number thus speaks of the Gould Packing Company's product:

This packing is a sure cure for leaky stuffing boxes, whether the motion is rotary or reciprocal, or whether the rod is round or worn oval or hollow. It becomes steam or water tight with a very small amount of friction on the rod. It is practically indestructible, and none is wasted, as it does not become hard and consequently does not have to be removed from the stuffing boxes. It is self-lubricating, which gives a saving in oil, and as it contains no soapstone or other polishing or grinding substances, does not wear the rod. Everywhere it has been adopted it has given unqualified good results.

When writing about the Dover, N. H., model electric light station—the notice of which appeared in THE ELECTRICAL WORLD last week—I omitted to mention that Mr. Fred. Austin, the chief engineer of the station, devoted all the time he could spare to showing me the points of interest about the engine and dynamo room and extending me other courtesies.

Mr. H. W. Burgett, the promoter of the Dover electric lighting enterprise, acknowledges his obligation to Mr. Austin for the painstaking labor of the latter in keeping the various departments of the station in systematic good order and in thorough discipline.

While in Dover, a week or two ago, I made a visit to the mammoth factory of Mr. I. B. Williams & Sons, tanners and manufacturers of oak-tanned leather belting. One of the firm extended me the courtesy of showing me through the extensive premises. The factory is one of the largest and best arranged establishments of the kind in New England. It is a brick building of five stories, and is built on rock and cement foundations. Each floor is a complete department in itself, with the exception of the first floor, which is principally occupied by the large offices, reception room and sample room. From cellar to roof the factory is completely equipped with all the requisite machinery and appurtenances for preparing every known grade and size of belting, from the rough and undressed hide, through the various stages, till finally the highly polished and artistically dressed oak-tanned belt is placed in the sample room. This company has one of its belts in use at the Dover electric light station, where it has been running a 50-arc light Thomson-Houston machine since the starting up of the electric lights there. The chief engineer of the station refers to the Williams belt in very complimentary terms whenever asked about its adaptability for use on dynamos and high speed engines. I understand that Mr. Samuel Kidder, No. 60 Federal street, Boston, keeps constantly on hand a full line of samples of belts manufactured by Messrs. I. B. Williams & Sons.

Mr. Samuel Elder, who has for some time represented the American system in this section, both as a member of the firm of Sowden, Elder & Wright, and as co-manager with Mr. Homer J. Goff, has become associated with the Thomson-Houston Electric Company. Mr. Elder has been connected with Mr. Edwards H. Goff for several years as private secretary, in fact, for some time previous to the latter becoming identified with electric lighting enterprises. The conscientious and persevering work of Mr. Elder for the American system, in the Northeastern States, has shown good results; it is safe to predict that he will be successful in his new field of labor.

I clip the following extract from an article which appeared recently in the Pawtucket (R. I.) *Evening Times:* "Every bank, jeweler and nearly every large store in the centre of the city of Providence now uses the Holmes burglar alarm telegraph system. This service has stood the test of years and throughout the country is acknowledged as the only absolutely perfect system to protect property, and the only thing that burglars cannot defy. The wires of this service may be attached to the safe, doors and windows of your store. If a burglar touches any of those wires, and he never knows it when he does give the alarm, four or five men immediately hasten to the bank or store, and that means the capture of the thieves. After you close your safe at night nobody can open it without giving an alarm. The lifting of a piece of silk goods from a pile of silks will give an alarm, if the silk counter is connected with the system. Then in case of fire or a water leak that is damaging your property, it will produce an alarm, so that assistance can always be summoned. The Holmes service insures perfect security, and New York, Boston and Providence banks and storekeepers would not be without it. The Holmes Company has recently placed one of its alarm indicators in the police station, on North Main street, and is now prepared to connect any of the business houses of the city with it. As an aid to the police it has no superior, for if there is any trouble at any store on the line, they know just where to go. The Holmes Company invite bankers, merchants and manufacturers to inspect their protective system and its workings at the police station. The local office of the company is at 18 Custom House street, Providence, in the Rose Building, and the Rhode Island manager is Mr. E. M. Carhart, a gentleman whose skill and experience in this business eminently qualify him for this work."

W. I. B.

PHILADELPHIA NOTES.

PHILADELPHIA, Pa., Dec. 12, 1887.

The breeze created by the legal opinion of the City solicitor, that the Penn Electric Company, which practically controls all of the underground franchises in this city, was not entitled to any of the privileges granted by City Councils, because it was a foreign corporation, and that the action of Council in granting it permission to lay conduits was illegal and void, is still creating somewhat of a sensation, and it is difficult at this time to foresee the result. One thing in favor of the Penn Company is the fact that it has a good portion of its underground work already completed, and the conduits are overlaid with the iron pipes of the Edison Company, so that, whether the privileges obtained are illegal or not, it would hardly be compelled to undo all this extensive work.

It has been stated upon excellent authority that there would be no investigation by City Councils into the methods by which the ordinances giving the Penn Company the privileges of the streets of the city had passed that body, but a sub-committee of the joint committee on law had already made a report recommending an investigation by the mayor and city solicitor to determine the exact status of the matter, and to prevent the exercise of the powers granted by the ordinances, which are declared void by the city solicitor on the ground that the Penn people had not complied with the State law relating to foreign corporations. The Penn was organized in New Jersey, and claims that it was duly registered in this State. Both the Penn and Edison companies are involved in the contest, and will be represented by able counsel to show that their actions have been within the pale of law. The remark attributed to a member of Common Council "that all companies must use our (the Penn) conduits" has been heard more than once—both in and out of City Councils. It is known, says a local paper, that a movement has been in contemplation for some time past by certain councilmen to have an ordinance passed by which it was intended to compel all the electric light, telegraph and telephone companies to go under ground within a certain time. It was hoped that if this should pass it would bring business to the Penn Company, and thus increase the value of its stocks. For some reason, not explained, the movement seems to have been abandoned. When a canvass of the lower Chamber was made it was found that not enough votes could be drummed up to secure the passage of such a measure. Then, again, opposition appeared against the scheme in another quarter, and the men who were behind the project feared that they would bring about an investigation that was not desired. The determination of the present administration to have a subway constructed and to have the city own it, was one of the most potent arguments against such a plan as some of the councilmen had proposed. It was stated semi officially that Mayor Fitler would not sign an ordinance to help the scheme of the Penn Company. When these facts were learned, the persons who had engineered the Penn Company ordinance through the City Councils began to unload their stock upon the public, and the price quickly fell from 50 cents per share to 17 cents, which is about the ruling quotation to-day. A leading member of the Electric Trust, which corporation controls the Penn Company said last week: "If it were not for the fear of Mayor Fitler the men who are powerful in councils would pass an ordinance that would give them absolute control of all the streets, and they would block the city from securing any rights in them."

As the case stands now, the Penn Company has as its franchise the right to lay conduits upon and in all the principal streets. The work that has been done, except in a portion of Chestnut street, has been performed by the Edison Company.

A gentleman who is well informed upon the subject said to a reporter: "Considerable money has been made and lost in operations with the Penn Company stock. The corporation originally appeared with 200,000 shares of stock. When it was determined to extend its operations the stock was increased to 1,000,000 shares at a par value of $1 each. The directors voted to one of their number a large number of shares, believed to have been at least 200,000, and that director was to place the stock where it would do the most good. One member of Councils, believing the scheme to be a good one, was loaded down with stock at prices ranging from 60 cents to 35 cents per share. He is believed to have secured 30,000 shares, the most of which he still holds. Another councilman was permitted to come in upon the ground floor, so to speak. He was given stock at $1 per share. A pool was formed, and 70,000 shares of stock were thrown upon the market last spring. Just what the proceeds were used for could never be learned. The projectors of the enterprise were voted handsome blocks of stock for their labors. These were sold to confiding purchasers, who have been compelled to bear the losses. Altogether about 700,000 shares of the stock have been sold. Since the price has declined to its present figures the representatives of the Electrical Trust have been purchasing the stock so as to make their position secure. The Trust paid for its first batch of stock 50 cents per share. Its control of the Penn Company franchises was made secure by several large holders pledging their stock to be voted and used as the Trust would indicate." The projectors of the enterprise sold as much of the stock as they could place to members of City Councils and public officials. The reason for this was explained in this language: "We thought that if the councilmen should be interested personally in the company they would take good care to keep other corporations out."

Much of the Penn stock is held by public men—politicians, storekeepers and others—who expected to reap a rich harvest from their investment because of the unusually valuable franchises held. Most of these persons paid 75 cents and $1 per share.

A special meeting of the directors of the Penn Company was held early this week to consider the opinion of the city's law officer. Among those present were Messrs. James McManes, David H. Lane, Tax Receiver Henry Clay, George E. Vickers and R. H. C. Hill. Col. B. K. Jamison and Professor Marks, of the University of Pennsylvania, were on hand as the representatives of the Edison Company; and Colonel Jamison was elected a director of the Penn Company. It was decided that the counsel for the company should appear before the Law Committe of City Councils and explain the legal status of that corporation. The Edison Company is deeply interested in the subject, because it has spent over $200,000 in laying its iron pipe on top of the Penn Company's wooden conduits.

Mr. Thomas M. Thompson, a member of Common Council from the Fifteenth Ward, was recently elected President of the Edison Company. He said yesterday that he did not believe that the opinion of City Solicitor Warwick would interfere with the contract that had been entered into by the Edison Company with the Penn corporation. "We made our contract in good faith," said Mr. Thompson, "and we have spent over $200,000 in laying our iron conduits in the territory between Fourth and Sixteenth streets and Walnut and Market streets. We will soon proceed to erect an electric light station on the south side of Sansom street above Ninth. Our plant will cost a full half million of dollars. I am not free to give the terms of the contract between the Edison and Penn companies for the privilege of laying our conduits on top of theirs, but the annual rental will hardly exceed $5,000 or $6,000."

The final outcome of the question is awaited with much interest, as many citizens are particularly anxious to learn just how much valuable privileges were given away to a private corporation at a time when the question of a municipal subway was being agitated and was received with so much favor by the public press and citizens generally.

Councils sub-committee on electrical matters failed to get a quorum last week, and as a result no business was done. Chief Walker, however, showed the members who were present a new style of door for fire-alarm boxes. He intends to give them a fair and practical test and within a week will have ten of them placed in position.

The new arrangement is known as Tooker's patent, and among the advantages claimed for it is the fact that no time need be lost in hunting for a key, as none is used. The door is opened by turning a knob to the right. This requires great pressure and as soon as the door is opened a large brass gong begins to ring. The tone of the gong is so loud that it can be heard for squares, even in the day time, and above the rattle and din made by passing wagons and street cars. Opening the door, however, does not send out the alarm. This must be done by pulling down a lever the same as at present. Should any one try to send out a false alarm, the ringing of the gong is bound to attract attention, and it would not be long before he would be in custody. Chief Walker thinks the new invention a good one.

Among the appropriations recommended by the Finance Committee of Councils for the coming year are these: For new electric lights, $25,000; for the extension of the police signal and telephone system, $10,000; for continuing underground conduits, $15,000.

A quorum of the Sub-Electrical Committee of Councils having failed to appear last Thursday, the question of allowing the Keystone Electric Light Company to extend their service by laying additional underground wires, and the Edison Company the privilege of opening the streets and laying their wires, were laid over until the next meeting.

At a meeting of the directors of the Philadelphia Time-Telegraph Company held last week Crawford Spear was re-elected president, George M. Brill vice-president, Gustav Stahl secretary, and Hans Weniger treasurer. The board includes the above named and C. John Hexamer, Dr. Adam Trace and Otto Fleming. A dividend of 5 per cent. on the capital stock of the company was declared. The company now has 252 clocks in operation in this city.

E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Dec. 10, 1887.

At the meeting of the Chicago Electric Club upon Monday evening last, Mr. C. K. Giles read an interesting paper upon "Magnetism in Watches and its Control."

I notice that the marriage of Dr. Sylvanus D. Cushman, of American-Cushman telephone fame, took place recently, to Mrs. Idella M. Burgheim, of Minneapolis, Minn. The marriage recalls the statement made by the doctor several months ago, to the effect that his marriage was dependent upon the result of his telephone suit. The case is not yet settled, but he certainly is confident of the result.

The incorporations this week are as follows:

The Chicago Postal Telegraph Company, at Chicago; capital stock, $500,000; to construct and operate lines of telegraph, telephone, and electric light, and to manufacture all kinds of electrical material and apparatus; incorporators, Marcus Pollasky, George L. Miller, and William S. Robbins.

Northwestern Electrical Accumulator Company, at Chicago; capital stock, $65,000; to deal in all kinds of electrical apparatus; incorporators, James W. Johnson, E. M. Hawley, and E. C. Loveland.

Foreé Bain has removed to 76 Market St.

It is understood that the presidency of the Chicago Gas Trust has been offered to C. Norman Fay, the second vice-president and general manager of the Chicago Telephone Company. The report is that the yearly salary offered is $20,000, and that is not at all unlikely, for when the Gas Trust wants to get a good man it does not stick at paying a good price for his services, and moreover it is doubtful whether a smaller sum would attract a man of Mr. Fay's admitted ability. Even with so tempting an offer it is understood that he has not yet accepted and may prefer to stick to electricity in the shape of telephones and lamps—for he is president of the Arc Light & Power Company—rather than to give himself up to gas.

Miss Theresa Brennan, manager of the Englewood Telephone Exchange, has been informed that by the death of an uncle, John Brophy, she had inherited $15,000 and the interest on the sum since 1880. The information came from Ottawa, Canada, Miss Brennan's late home. The young woman lives with her brother, J. M. Brennan, at No. 350 Chestnut street. She knew nothing of the circumstances under which the money was left. Her sister, who shares the amount with her, came of age three months ago. Miss Brennan and her brother will leave next week for Ottawa. Miss Theresa is pretty, and is well and favorably known in Englewood society.

When the Western Edison Light Company was absorbed, at the time the changes were made in the Edison parent companies, some little while ago, Humbird & Gordon were appointed the managers of the Western section of the Edison business. On Sept. 1 last Humbird & Gordon gave up that part of the work, and were succeeded, so far as Illinois, Indiana and Iowa were concerned, by the firm of Leonard & Izard, who had up to that time done the wiring, construction and installing of the Edison plants throughout the Western territory. In addition to being agents for the three States named, Leonard & Izard also do construction work in Minnesota, Nebraska and Dakota. Mr. Humbird, by the way, has, viewed from the Edison standpoint, fallen from grace, having gone with the Westinghouse Company. Mr. Gordon is secretary of the local Chicago Edison Company. Leonard & Izard have certainly made a good showing since they took charge of the business Sept. 1. They are now at work on 42 separate contracts in different parts of the West. Among the most important of these may be mentioned four contracts from Chicago & Northwestern Railway as follows: The passenger station of the company in Chicago, 750 lights; the company's West Chicago Shops, 1,300 lights; Clinton, Ia., shops, 350 lights; Winona, Minn., shops, 300 lights.

They are also doing considerable stockyard work. One contract of this nature is from Nelson Morris & Co., of Chicago, 1,200 lights. Another is from Armour & Co., 500 lights. Swift & Co. have ordered 2,000 lights. This is in addition to the 1,000-light plant they now have. Fowler & Co., who have a 400-light plant in Chicago, have ordered 300 lights for their branch establishment at Omaha. What Mr. Leonard believes will be the largest isolated plant in the world is to be put in "The Rookery," an extensive, massive and handsome structure now in progress of erection, not far from the new Board of Trade. This plant is to consist of 4,000 lights.

A plant of 1,000 lights is to be started up in a few days in the office building of the Chicago, Burlington & Quincy Railroad in Chicago. Selz, Schwab & Co. have given an order for 600 lights; Crane Bros. for a fourth plant of 250 lights, the Wisconsin Central Railroad for 250 lights for their Waukesha, Wis., shops. The Dakota penitentiary at Sioux City is to have a 225-light plant. The Shattuck school, at Faribault, Iowa, is to have 750 lights. There is also a contract for 800 lights at Pullman, Ill., and many other smaller orders from different points. Central stations have been installed at the following places since Sept. 1: Winona, Minn., 500 lights; Decatur, Ill., 600 lights; Paris, Ill., 500 lights; Peru, Ill., 450 lights; Sioux City, Dak., 500 lights; Baraboo, Wis., 300 lights; Jerseyville, Ill., 600 lights; Monmouth, Ill., 450 lights.

The central station of the Chicago Edison Company, now building, will undoubtedly be one of the model stations in America. When it is ready to start up—probably in February—it will be, so it is claimed, the largest central station in existence. The new Edison uptown stations in New York will be larger, but they may not be ready by February. The building, which will be used solely by the Chicago Edison Company, will be an exceedingly substantial and well-arranged structure, while the location is central and in every way desirable. The size is 45 by 190 feet, three floors and basement. Conductors are laid and all the arrangements made for 35,000 lights, though the station will start up with a capacity of about 10,000 lights.

Street lighting systems have been installed since September 1 in the following places: Oscaloosa, Ia.; Baraboo, Hudson and Broadhead, Wis.; and Olney, Paris, Jerseyville, Monmouth, Peru and Edgewater, Ill.

The latter place, Edgewater, situated about eight miles from Chicago, is a new town and is not unlike Tuxedo Park, near New York. It is composed almost wholly of handsome residences, and being a new place very sensibly adopted the electric light as its sole method of illumination. There are no gas pipes or anything of the kind in the town; no oil is used, and no lights of any kind are burned in the streets, stores or houses except the electric light.

Leonard & Izard are doing something with the storage battery, and furnishing quite a number of estimates for electric street railways, the electrical transmission of power and the like. They say that that the new Edison lamp is meeting with much success in the West and giving excellent satisfaction.

The Edison plant in the People's Theatre at Minneapolis has also received a very warm indorsement from the proprietor, Mr. Lambert Hays, who says: "The electric light put in my theatre by your company is far beyond my expectations. Its system of lighting is perfect." Mr. Hays regards the controlling apparatus as the most complete he has ever seen, and states that he is getting full 12 sixteen c. p. lamps per h. p., if not more, with a lamp life "away beyond a thousand hours."

The Western Electric Company is, as already noted, erecting a new wing as an addition to its present large factory. It has now 100,000 square feet of space, and will have, when the change is made, 150,000. The new wing will be ready by April, and conforms in style to the rest of building, but is fire-proof. The company proposes to increase all the different departments, the new part not being intended specially for any one department or class of work, but will allow elbow-room for the increase of each and all. In the electric lighting business the company continues to make an excellent record, and its circular on the subject recently issued gives a long and striking list of private concerns and local companies using this apparatus in all parts of the country. The company says that its light is particularly desirable on account of its whiteness and steadiness. Prismatic tests show, it is said, that the light from the Western lamps is more like sunlight than that furnished by any other system in the market, the obnoxious blue and pink rays being missed because they are not there. In its telephone department the company is, as usual, overrun with work, the orders now in hand aggregating 100 sections of multiple switch-board. As each section is usually intended for 200 subscribers, this means equipment for about 20,000 subscribers in all; but some of these sections are intended for as many as 300 subscribers. Portland, Ore., makes new provision for 600 subscribers, Memphis for 1,200. Omaha increases its equipment from 1,200 to 1,400. Chicago takes 23 new sections, consolidating two downtown exchanges. The new Chicago Exchange building at the corner of Washington and Franklin streets, is to be five stories and basement. This building, by the way, presents a good architectural combination, being of Wisconsin granite on the first floor and basement, and dressed brick and terra-cotta above that. The Chicago Telephone Company, and the Central Union Telephone Company, are to occupy the whole building, which is now nearly completed. The switch-boards will be installed by Feb. 1, or thereabouts, and the new exchange will be opened about May 1. The wires are all to be brought in underground. Coming back to the Western Electric Company, it may be mentioned that Detroit adds one section, Buffalo takes 5 new sections of 300 subscribers each, Providence 5 new sections of 300 each, Brooklyn 5 of 300 each, and Rochester two new sections of 300 each. In its general line of annunciators, burglar alarms and general electrical supplies manufactured and dealt in by itself, the Western Electric Company is busier than it ever was at any preceding stage of its history.

Col. S. G. Lynch, broker, 146 La Salle street, furnishes me the following quotations upon telephone stock:

Bell of Mo.	$160@$165
Central Union	44@ 45
Chicago	375@ 390
Colorado	19@ 21
Cumberland	62@ 65
Great Southern	30@ 32
Iowa Union	28@ 30
Michigan	76@ 77
Missouri and Kansas	68@ 69
Rocky Mountain Bell	40@ 45
Wisconsin	108@ 109

C. H. M.

THE TELEGRAPH.

Brenham, Tex., is to put in a fire alarm system.

Chicago.—At Chicago, on Dec. 3, the grand jury indicted no fewer than fourteen bucket-shop keepers. The appearances are that the law against this species of gambling will be rigidly inforced.

No Trouble Among the Pooled Cables.—Mr. H Weaver, managing director of the Anglo-American Telegraph Company, writes to the English newspapers, flatly contradicting the report with regard to dissensions among the pooled cables.

Must not Use French Cable Blanks.—Judge Lawrence, of the Superior Court, granted an injunction on Dec. 7 in favor of the French Cable Company, restraining the Western Union Telegraph Company and the Direct Cable Company from using the blanks of the French Company and from receiving cablegrams on blanks bearing the inscription "Via French Cable."

Philadelphia, Pa.—It is now Philadelphia's turn for bucket shop raids. On Dec. 7 the police there arrested no fewer than eighteen brokers and clerks, charging them with keeping gambling houses. They were placed under bail and released. The members of the Stock Exchange in Philadelphia are very much pleased at this course, and think that the bucket shops will not be able to recover from the blow.

Cable Rates.—There is a good deal of gossip as to changes likely to be made in the near future in cable rates. It is said that nothing has yet been decided on this point, and that the first advance made in common by all the cable companies will not bring the rates above 20 cents, and that in no event will the rate exceed 40 cents. There are many reports current as to squabbles in London between the pooled companies. One report states that Mr. Jay Gould has started up this rumpus by demanding better terms for the Western Union Company.

The Hero Messenger Boy.—Young Sanger, the district messenger boy who took the "Highest Bidder" souvenirs to Europe to Mr. Sothern's friends, is being made a hero of by messenger

boys throughout the country. He is a regular member of the company, and when he appears in the second act always meets with a rousing reception. At Baltimore the other night 50 of the regular messenger boys attended the performance, sat in a body in the dress circle, and gave Sanger quite an ovation, as well as a large bouquet. After the performance Sanger invited the young gentlemen to "un petit souper."

The Government Telegraphs.—General Master Workman Powderly, in a letter to the Order of the Knights of Labor, published in the last number of the *Journal of United Labor*, makes a vigorous attack on the Western Union Telegraph Company, and recommends that the United States Government should control all telegraph lines. He thinks it is wrong that the stock of the only telegraph system in the Union should be largely in foreign hands, arguing that the government can as well transport dispatches as mail bags, and ridicules the argument that the government system would be a new channel for party influence, by stating that the total number of telegraph operators in the United States would not exceed 17,000, who would not be found to vote for the government candidate under civil service rules any more than the employés of the post-office are. He claims that every item of news that militates against the interest of the masses and operates to the welfare of monopoly is wired through from one end of the country to the other, while that which is not favorable to monopoly is suppressed.

Bucket Shops in New York and London.—Whatever may become of the bucket shops here in New York, their prototypes in London are flourishing, and seem unlikely to close for some time to come. In the English metropolis these establishments advertise very largely in a very picturesque and captivating way. Here they depend upon their customers almost altogether to circulate the knowledge of their business and the location of it. In London the advertisements of what they call bucket shops here may be found in all the leading financial papers. One of them, under the title of J. Lewis Mills & Co., limited, advertises that their capital is £250,000, and their chairman is Sir Francis Knowles, Bart., M. A., F. R. S. This gentleman is the secretary for the Queen. The advertisement goes on to state that the company undertakes stock exchange business at half the rates usually charged by other brokers, and that speculative accounts are opened on 1 per cent. recover. The machinery of the business seems to be more elaborate and more complete than exists here, for their advertisement states that they will send a special telegraphic code post-paid to country clients, and that all telegrams are free.—*N. Y. Mail and Express.*

Speculative Congressmen.—A curious rumor has been afloat in "the street," to the effect that the "movement" for a Government telegraph, which crops out in widely disseminated petitions and certain newspaper editorials, is part of a scheme to entrap speculative Congressmen. As the story runs, the movement has been fostered in a measure by certain bull operators, who are anxious to create a short interest in Western Union among the legislators of the nation, with a view to "squeezing" them by an upward movement soon afterward. There are many who doubt the probability of this action, but nobody doubts the disposition of many Congressmen to speculate on their own inside knowledge of probable legislative results. It is a mistake, however, to suppose that Congressmen have opportunities thus for a simple and unquestionable success in money making. On questions where so many subtle influences are at work as the regulation of government and railroad finances, a Congressman is apt to be as much in the dark as anybody else on the question of the final vote. Moreover, he cannot see the inside workings of Wall street, which are often quite as important as the events which are supposed to regulate the course of the market.—*Commercial Advertiser.*

THE TELEPHONE.

Improved Telephone Apparatus.—The American Telephone Improvement Company has been organized at Portland, Me., by C. H. Drew and others, with a capital stock of $1,000,000.

Charleston, S. C.—It has been recommended by the board of police commissioners of Charleston, that a police telephone and signal service be put in at a cost of about $10,000 to $12,000. No definite action has yet been taken in the matter.

That Bell Telephone Decision fails to come to hand, although two months beyond the time expected. The longer the delay the greater becomes the uneasiness among the smaller stockholders. The Drawbaugh people, on the other hand, are gaining courage, and, on the principle of "counting chickens before they are hatched," are figuring out the probable value of their stock *if* the decision shall be favorable to them. They figure very big, asserting with the greatest possible amount of confidence that, with the condition contained in that little "if" fulfilled, $500 per share will not be far out of the way. The situation for these people at the present time is certainly one of intense interest and anxiety, but they will have to stand the strain until the Supreme Court finds itself ready to relieve it. Just how far it will do to buy Drawbaugh stock is something that one man can tell as well as another.—*Boston Post.*

THE ELECTRIC LIGHT.

Fulton, N. H.—The village of Fulton is to have an electric light plant.

Hamburg, Germany, has in use 325 arc and 5,300 incandescent lights.

Slatington, Pa.—An electric light plant has been put in at Slatington, Pa.

Golden, Col., has closed a contract for electric lighting with a local company.

Holland, Mich.—It is proposed to erect an electric light plant at Holland.

Leominster, Mass.—The Leominster Worsted Company is to put a Loomis plant in its new mill.

Warren, O.—The Etna Machine Company has ordered a 10-light plant from the Brush Electric Company.

Fort Scott, Kan.—The Peoples' Light, Heat and Power Company, of Fort Scott, Kan., has been incorporated by A. Harris, C. H. Osborn, W. C. Green and others, with a capital stock of $100,000.

Pullman, Ill.—The vast shops of the Pullman Palace Car Company are to be lit throughout by electricity.

Saccarappa.—The Haskell Silk Company, at Saccarappa, is to put in a plant of the Loomis system in its mill.

Birmingham, Ala.—The Birmingham Safe and Lock Company will put an electric light plant in its new factory.

Ironton, O.—Applications for electric light franchises at Ironton are being held in abeyance by the local council.

Oxford, N. C.—Negotiations are now going forward for the construction of the electric light plant proposed for Oxford.

Raw River, N. C.—A new weave mill has been erected at the Granite Cotton Mills and an electric light plant installed.

Lynchburg, Va.—Mr. Cecil P. Pool will put in an electric light plant at Lynchburg, and has ordered the apparatus, etc.

Buffalo, N. Y.—The Buffalo Illuminating Company has been incorporated by D. E. Bailey and others, with a capital stock of $100,000.

Warren, Mass.—Owing to the recent destruction of the private gas plant of Sayles & Jenks by fire, electricity is to be substituted.

Springfield, O.—The shops of the Warder, Bushnell & Glessner Company are being fitted up with an incandescent plant of 600 lights.

Jacksonville, Fla.—The electric light plant for the Sub-Tropical Exposition at Jacksonville is being put in by the Thomson-Houston Company.

Presque Isle, Me.—The Presque Isle Electric Light Company has been incorporated by J. W. Bolton and others, with a capital stock of $10,000.

Newark, N. Y.—It is proposed to put an Edison plant in operation at Newark. Another scheme on foot is to bury all the electric light wires there.

Altoona, Pa.—The Mountain City Electric Light Company, of which L. Black is president and W. H. Mackley secretary, is erecting a plant to cost $35,000.

Medina, N. Y.—The contract made by Medina for electric lighting with the Thomson-Houston Company is for forty 2,000 c. p. lights, at $62.50 each per annum.

Arc Lamp Litigation.—The Brush suit against the Fort Wayne Jenney Company for infringement is being tried at Indianapolis, and not at Detroit as before stated.

Williamsport, Pa., has closed a contract for 80 street lights, at the cost of $95 per light per annum. The contract has been made for two years with the local Edison Company.

Milwaukee, Wis.—The Badger Illuminating Company has obtained a contract from the city council of Milwaukee, from Dec. 15 until Dec. 5, 1890, to operate 30 arc lights of 2,000 c. p. each on the streets, at a cost of $150 a year.

Mount Vernon, N. Y.—At a meeting of the Board of Trustees of Mount Vernon, held on Dec. 6, a contract was entered into with the American Company for the supply of thirty arc lights on the streets for one year at the rate of $100 per light.

Pine Bluff, Ark.—Mr. W. I. Wark, of the Pike Electric Company of St. Louis, has organized an incandescent lighting company at Pine Bluff with a capital stock of $10,000, and will begin to erect a plant as soon as the necessary permit is secured.

Philadelphia Ferry Boats.—The ferry boats belonging to the Pennsylvania Railroad running between Philadelphia and Camden are to be lit by electricity. Engines for the purpose have already been placed on the Market street and Federal street boats.

Bristol, Tenn.—The Bristol-Goodson Electric Light and Power Company has been organized to operate the Thomson-Houston plant previously reported, with George W. Kubnert as president; John P. Steffner, secretary; and J. C. Anderson, treasurer.

Alexandria, Va.—Mr. J. M. Hill, connected with the local opera house, is endeavoring to organize a stock company at Alexandria to put in an electric light plant. Should he not succeed in carrying out this plant he will put in a consolidated plant for his own purposes.

Fayetteville, Tenn.—The Fayetteville Electric Light and Power Company was organized on Dec. 3. A contract has been placed with the Jenney Electric Company, of Indianapolis, for an arc plant of 32 lamps capacity. This plant is to be in operation early in January next.

Amsterdam, N. Y.—The Carmichael paper mill at Amsterdam is to put in an incandescent plant of the Loomis system. Shuttleworth Brothers are also to put in a Loomis plant at their carpet factory, and Horace Inman & Son are increasing their plant from 85 to 1,500 Loomis lamps.

The Eiffel Tower.—It is stated by the *Bulletin Officiel* of the Paris Exhibition of 1889 that great progress has been made with the Eiffel Tower. The girders of the great structure now overtop the high houses near the Champ de Mars, and the first gallery will soon be finished.

Goldsboro, N. C.—It is stated that in case the proposed electric light station, of which mention has already been made in these columns, should not be erected, the firm of Hunter & Street will put in a plant. Mr. H. A. DeKay has been on the spot negotiating for the erection of a plant.

Orange, N. J.—A petition asking the township committee to grant the Edison Illuminating Company, of the Oranges, the privilege of erecting poles in East Orange, so that it may furnish incandescent light, is being extensively signed by property owners, and the work is progressing in good shape.

Hallowell, Me.—It is stated that the Electric Light Company, at Hallowell, has been unable to secure poles on which to put its wires, owing to the great demand that has existed for poles for electrical purposes all through the State. There will be a delay in going into operation on this account.

Rome, Ga.—The Rome Gas Company writes to the Baltimore *Manufacturers' Record* as follows: "We have decided to erect an electric light plant as soon as we can decide as to the comparative merit of the different systems now being used throughout the country. We expect to be ready to furnish light within two or three months."

New Rochelle, N. Y.—The trustees of New Rochelle made a contract recently for the installation of a number of arc lights on the principal streets. Mr. Roth, one of the trustees, was also interested in the company, and it was objected that this made the contract invalid. The matter was taken before Judge Culley, who decided that the trustees were acting fully within their powers, and that the original contract was in no way vitiated.

Gouverneur, N. Y.—The Gouverneur Electric Light Company, recently organized, as stated by us, and operating a plant with the American system, pays the Gouverneur Machine Company $1,350 per year for power, labor, etc., and receives from the village $1,200 per year and 25c. per night for private lights. It now has in use 50 arc lights, of which 22 are on the streets. It is also running some incandescents. The machine company has put in a new boiler and engine of over 100 h. p. capacity. The stock of the company is $20,000, of which 60 per cent. is paid in. The officers are: President, E. D. Barry; vice-president, W. F. Sudds; secretary, C. A. Parker; treasurer, V. V. P. Abbott.

Orange, Mass.—The local Electric Lighting Company at Orange is now putting in a 30 light arc dynamo and a 250 light incandescent dynamo, both of the Thomson-Houston system, for the purpose of street and commercial lighting. A good business for both kinds of light has already been secured. The capital stock of the company is $10,000, and the majority of it has already been taken by Orange people. Room and water power are obtained for the present of the Chase Turbine Manufacturing Company, although it is intended later by the company to put in a steam plant of its own. The officers of the company are A. L. Shattuck, president and secretary; W. M. M. King, treasurer, and these are directors with G. P. Warner.

Pawtucket, R. I.—The Pawtucket Gas Company has completed a building 125 feet long and 28 feet wide at the old station of the gas company at Central Falls, for the purpose of putting in an electric light plant to supply that district. The company has contracted with the Jarvis Engineering Company for two boilers developing 300 h. p. and an Armington-Sims engine of 100 h. p. This will be employed in driving two 50 light dynamos with complete equipment of lamps furnished by the New England Agency of the American Electric Manufacturing Company. The plant will be ready for operation early in January. As the company has a plot 350 feet long and 280 feet deep on the line of the railroad it can make any extension demanded by the increase of the business. Mr. L. B. Darling is the president of the gas company, and Mr. S. G. Stiness superintendent.

Incandescent Lamps on Harbor Lights.—The idea of lighting buoys in New York harbor by electricity is soon to be tried at Staten Island, under the direction of Lieut. Com. McKenzie, U. S. N., and Lieut. John Millis, U. S. A. A contract has just been made for 2,000 feet of submarine cable to be run out from Tompkinsville, S. I., to one of the buoys, on which will be placed a 30 c. p. incandescent lamp furnished with current through the cable from a small dynamo in the light-house tower. If this light works satisfactorily, it is expected that all the lighted buoys in the harbor will be supplied in the same way, so that the services of oilmen and the oil supply boat can be dispensed with for such work. It is not likely that the cables will be dragged or broken by anchors, as they will be laid across the bottom, where anchors are seldom cast, and they will also be quite out of the track of ocean going steamers.

APPLICATIONS OF POWER.

Anniston, Ala.—The Anniston Street Railway Company, which is to use electric motors, is now laying its tracks.

Washington, D. C.—It appears now to be definitely settled that the Belt Line Railroad Company will use electric motors on its new lines.

South Pittsburgh, Pa.—The South Pittsburgh Power Company has been incorporated by J. W. Patterson and others, with a capital stock of $10,000.

St. Augustine, Fla.—A company is to be incorporated by H. Canfield, G. W. Attwood and others to build the electric railroad in the city of St. Augustine.

Charleston, S. C.—The Ashley Bridge Company, for which a bill of incorporation is now before the State Legislature, will give attention to the use of electricity on its road.

Lebanon, Pa.—The electric railway enterprise at Lebanon is now in good shape. The company has obtained a charter, and its franchise has already passed the first reading in the Select Council.

Novel Use of Electricity.—During the arguments in a spindle litigation, heard before Judge Colt, in Boston, recently, one of the contestants had a spinning frame running in the court room by electricity to illustrate its side of the case.

Chattanooga, Tenn.—The Chattanooga & Spring Lake Railroad Company has been organized by F. J. Barrett, S. E. Green, D. C. McMillan, J. P. McMillan and J. R. Barnett. The company is authorized to use steam dummies, cables or electric motors.

Providence, R. I.—The subject of cable and electric roads has been in discussion at Providence recently, and has been taken great interest in by the public. The Ries system attracted considerable attention. Supt. Longstreet, of the Union Railroad Company, is understood to be favorable to electric motors, and it seems likely that the new road up College Hill in Providence, will be equipped with some electric system.

Runs with Storage Cars.—Mr. W. Wharton, Jr., president of the Electric Car Company of America, writes as follows: "We ran yesterday, Dec. 9, our new eight wheel car equipped with two Reckenzaun motors and 116 cells of Electrical Accumulator Company's (33 C) make around the track at our yard the distance of 63 miles 211 feet in 8 hours, with one charging of the batteries. This run was accomplished over the same severe track at our works that I described in my previous letters to you. In this run there were 331 curves of 33 feet radius, 662 curves of 50 feet radius, and 331 curves of 100 feet radius (the curves averaging a

right angle or 90 degrees each), besides 5 miles 2,390 feet of 5.8 per cent. ascending grades."

MISCELLANEOUS NOTES.

San Francisco, Cal.—The Electrical Development Company, of San Francisco, was incorporated recently by G. S. Ladd and others, with a capital stock of $1,000,000.

Philadelphia Electric Club.—It appears that the Philadelphia Electric Club cleared $374 by its recent benefit entertainment. It has been decided by the board of managers that the regular business meeting shall be held on the first Saturday evening of the month. The second Monday and the third Saturday evenings of each month will be devoted to entertainments.

Revision of the Patent Law.—Mr. Arthur Steuart, legal counsel of the National Electric Light Association, will read a paper on "Revision of the Patent Law" before the American Institute of Electrical Engineers, on Tuesday evening, Dec. 20, at 8 o'clock, at the house of the American Society of Civil Engineers, 127 E. 23d street, this city. The subject is one of unusual interest and will provoke a lively discussion, out of which good should come, in the way of rendering the patent system more effective.

PERSONALS.

Mr. G. H. Babcock, of the Babcock & Wilcox Boiler Company, has been elected a school trustee at Plainfield, N. J.

Mr. S. Spencer, it is interesting to note, has been elected president of the Baltimore & Ohio Railroad in the place of Mr. Robert Garrett, resigned. His salary is fixed at $25,000.

Mr. Fred T. Fuller comes out in the Boston *Sunday Globe* with a signed editorial on postal telegraphs. The article favors buying existing systems at their actual value, and, as a means to that end, urges that Congress authorize the construction of new lines, as well as the purchase of those now in use, devoting a portion of the treasury surplus to the investment.

Mr. S. D. Niwa, M. E., of Tokio, Japan, is now in this country on a tour of investigation of central stations for incandescent lighting, and is indefatigable in his inquiries on this subject.

Mr. W. A. Somerville.—One cannot help noting the stooped shoulders of W. A. Somerville as he passes along. He is the manager of the press department of the Western Union Telegraph Company, and looks as though he carried the world on his back. It does not seem that it is twelve years since I saw him, erect as an arrow, keen and vigorous, in attendance on the Democratic National Convention at St. Louis, where Tilden was nominated for President. He was then the principal representative of one of the lines that opposed the Western Union. His mustache and goatee, which were then black, are now as white as snow.—*New York Tribune.*

BUSINESS NOTICES.

Hine & Robertson, 45 Cortlandt street, New York, make special inducements to electric light superintendents and engineers to introduce "Eureka" packing and other specialties. It will pay to communicate with them.

E. P. Allis & Co., the well-known engine and machinery builders, of Milwaukee, Wis., have issued a handsome broadsheet calendar for 1888. It gives views of the Bay State and Reliance works. The months are printed on detachable slips.

Jordan & Gottfried, 208 Canal St., N. Y., carry a complete stock of iron and brass machine and wood screws, bolt cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

Self-Winding Clocks.—An elegant line of self-winding clocks has just been received by the American Manufacturing & Supply Company, 10 and 12 Dey street. They are offered to electricians, for the holidays only, at very reasonable prices. These clocks are wound by an electric motor, with open circuit battery, and in the mantel form are finished in dark marble of antique Greek and Roman designs. The batteries are concealed in the clock on either side of the works. These clocks are guaranteed for one year, though from the tests made it appears that one could count on two years correct running. Before investing in holiday presents, call and investigate or write.

STOCK QUOTATIONS.

The following list, compiled by Mr. J. S. Stanton, 18 and 18 Broad street, gives the current quotations of electrical stocks:

Dec. 13, 1887.

TELEGRAPH.	Bid.	Asked.
Am. Dist.	30	37
Am. Tel. & Cable	70½	72
Cen. & So. Am.	90	100
*Com. Tel	.....	.....
*Gold & Stock	90	95
*Inter. Ocean Tel.	82½	.....
N. Y. Mutual	80	90
Pac. & Atl.	50	.....
*Postal T. & C.	27	30
South. & Atl.	70	80
W. U. Tel.	76½	77
W. U. Scrip.	75	78
W. U. Bonds.	118	119
Mut. U. Bonds	83	84
TELEPHONE.		
Am. Bell	210	212
Am. Speaking	110	120
Erie	30	31
*Hudson River	47½	55

TELEPHONE.	Bid.	Asked.
Mexican	.....	.....
*N. Y. & N. J.	80	90
N. Y. & Pa.	.....	.....
New England	.....	.....
*Southern Bell	.....	.....
ELECTRIC LIGHT.		
*Am. Electric	.....	45
*Brush	.....	.....
*Brush Ill	.....	50
*Consolidated	8	.....
*Daft	.....	.....
*Edison	140	160
*Edison Ill	75	85
Edison Isolated	110	.....
*United States	.....	50
*U. S. Ill	.....	90
MOTOR.		
*Daft	.....	.....
*Sprague	85	100

* These stocks are so seldom dealt in that it is difficult to give price at which they can be bought or sold. The figures given are as near as can be ascertained.

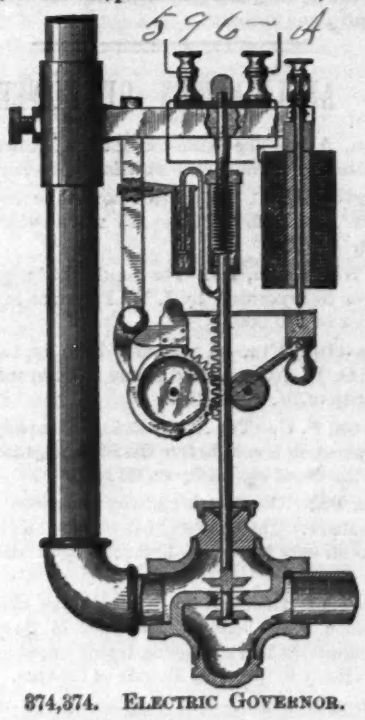
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED DECEMBER 6, 1887.

(1) 374,164; (2) 374,166. Apparatus for Covering Wire and Soft Metal; J. C. Appleby, Jersey City, N. J. Applications filed respectively March 15 and April 26, 1887. The ram-head is provided with a tubular guide; also with a die longitudinally adjustable with reference to the guide. A pulley is arranged in the wire passage, around which the wire passes, thus preventing the wire from bending to an acute angle while passing through the machine, this being one of the features of the invention.

374,173. Apparatus for Converting Heat Energy into Electrical Energy; Willard E. Case, Auburn, N. Y. Application filed July 28, 1886. Improvement on the Apparatus covered by patents of June 29, 1886, Nos. 344,345, 344,346 and 344,347, and described in THE ELECTRICAL WORLD of July 17, 1886. The inventor uses a liquid containing chromic chloride, a carbon element and an element of tin combined with mercury in the form of a liquid or viscous amalgam. The cell thus formed is subjected to heat to generate a current.

(1) 374,198. Contact Brush; (2) 374,199. Rail Connection for Electric Railroads; Edward L. Orcutt, Somerville, Mass. Application filed Feb. 7, 1887. (1) The



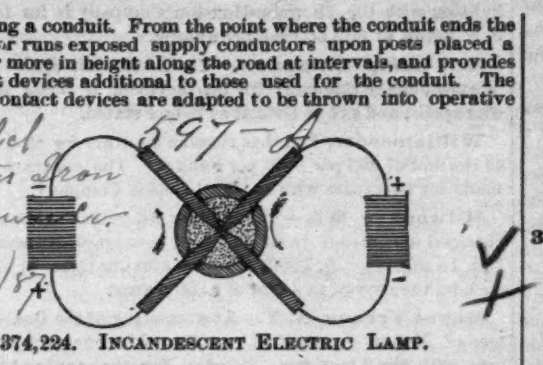
374,374. ELECTRIC GOVERNOR.

contact brush is adapted for use upon a traveling vehicle, as upon a locomotive, to make contact with a rail. The brush consists of a metallic body having angular apertures formed in it, and brushes extending through the apertures. Each of the latter brushes is arranged against one side of the aperture, and transverse to the conductor with which it engages. Wedges secure the brushes in the apertures. (2) Pins of copper or other substantially non-corrosive material fit tightly in sockets in the rails, and a metallic strip overlapping the abutting ends of the rails comes in contact with both pins. See illustration.

374,224. Incandescent Electric Lamp; M. Wheeler, Boston, Mass. Application filed Feb. 4, 1887. A suitable frame or holder contains an amorphous mass of zirconia which surrounds the inner ends of the filaments, the outer ends being connected to different batteries. See illustration.

374,225. Electrical Dental Engine; G. W. Whitefield, Evanston, Ill. Application filed Aug. 16, 1887. Electrically operated stop mechanism is provided for suddenly bringing the tool to rest. A key is arranged within reach of the operator for throwing the mechanism into action.

374,236. Electric Railway; Edward M. Bentley, New York, N. Y. Application filed April 9, 1887. The invention is designed for use where a city road is extended out into the suburbs and where it becomes unnecessary to go to the expense of laying a conduit. From the point where the conduit ends the inventor runs exposed supply conductors upon posts placed a foot or more in height along the road at intervals, and provides contact devices additional to those used for the conduit. The extra contact devices are adapted to be thrown into operative



374,224. INCANDESCENT ELECTRIC LAMP.

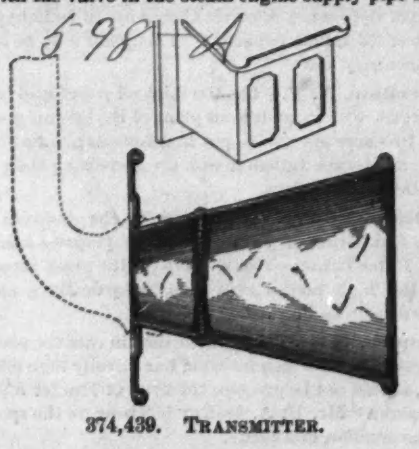
position to connect with the exposed conductor when that section of the line has been reached.

374,315. Conduit for Cable or Electric Railways; Wm. Nier, Kansas City, Mo. Filed Dec. 30, 1886. This consists of a cast-iron section having a longitudinal opening for the passage of the grip. The flanges project upwardly, to which the slot irons are fastened.

374,329. Galvanic Battery; Henry E. Waite, New York, N. Y. Application filed May 5, 1886. A battery tray containing the cells is supported upon a platform, the latter being provided with handles for raising it. A removable hydrostat is arranged above the tray, and a recess is made under the platform to receive the hydrostat. The object is to provide a convenient battery for medical purposes.

374,348. Underground Conduit for Electrical Conductors; G. W. Cook, Detroit, Mich., Assignor of one-half to C. B. Cole, same place. Application filed Sept. 24, 1887. This is a rectangular partitioned box built in sections of wood and saturated with asphalt and shellac. The sections have beveled ends which fit into each other and the joint is surrounded by a box, the interstices being filled with tar paper.

374,374. Electric Governor; W. H. Reynolds, Washington, D. C., Assignor to the Columbia Electric Light and Motor Co., West Virginia. Application filed March 26, 1887. Variations in the speed of the generator vary the strength of a magnet in circuit with the generator. The magnet armature is connected with the valve in the steam engine supply pipe by multi-



374,439. TRANSMITTER.

plying gearing. The steam is therefore controlled by the generator. See illustration.

374,381. System of Electrical Distribution; M. Waddell, New York, N. Y. Application filed July 2, 1887. A duplicate set of omnibus conductors and suitable switches are located at the central station, whereby any one or more feeding circuits can be readily connected to the supplementary set instead of to the regular set. In this way the system may be divided, and any part in which a fault occurs may be run from a dynamo separate from the rest of the system, so that the current of the whole system will not be affected.

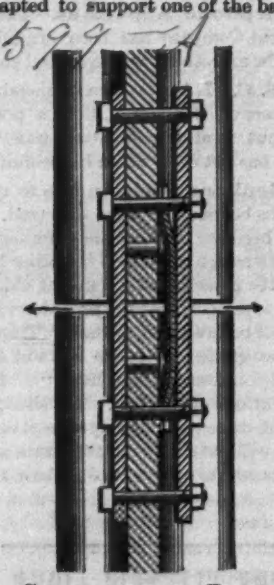
(1) 374,390. Telegraph Transmitter; (2) 374,444. Printing Telegraph; A. Bixby, Baltimore, Md., Assignor of (1) to G. W. Graffin, same place, and of (2) three-fourths to S. G. B. Cook, of same place. Applications filed respectively June 11, 1887, and Sept. 1, 1886. (1) A vibratory conducting finger is arranged to traverse an interrupted conducting plate a greater or less distance according to the letter to be printed, and to return immediately to its original position. Means are provided for advancing and retracting the finger. (2) A hollow transmitting cylinder is made up of a series of non-conducting wheels having conducting plates inserted in its periphery, and these wheels are alternated on the shaft with conducting wheels, which serve the double purpose of separating the non-conducting wheels and of connecting electrically the plates in the non-conducting wheels.

374,404. Regulator for Electric Currents; S. D. Field, Yonkers, N. Y. Application filed March 17, 1887. Conducting plates are immersed in an electroyte, and are connected with the circuit. The plates are made of non-oxidizable material. A non-conducting plate is arranged to be interposed between the plates to any desired extent, so as to cut off the current entirely or interpose any amount of resistance.

374,406. Regulation of Electric Generator; D. Higham, Philadelphia, Pa., Assignor to the Higham Electric Motor Company, of same place. Application filed March 2, 1887. The field and armature coils are in series in the working circuit. A shunt is arranged around the series and an electro-magnetic circuit breaker is located in the working circuit to close the shunt circuit.

374,439. Transmitter; R. W. Whitney and F. Pultz, Cleveland, O. Application filed May 31, 1887. An independent mouth-piece for telephone transmitter, provided with a reticulated or perforated diaphragm for diffusing and equally presenting the sound-waves to the main diaphragm. See illustration.

374,456. Galvanic Battery; J. F. Crouch, Eugene City, Oregon. Application filed Sept. 2, 1887. A peculiarly constructed box adapted to support one of the battery elements so



374,199. RAIL CONNECTION FOR ELECTRIC RAILROADS.

that it may be revolved to bring fresh portions into contact with the liquid.

374,458. Underground System for Electric Wires; J. P. Davis, New York, N. Y. Application filed July 11, 1887. The novelty in this invention lies in the construction of the man-hole cover to prevent water from entering and to provide a tight cover generally.

374,495. Coin Operated Induction Coil; W. R. Pope, Baltimore, Md. Application filed Aug. 31, 1887. A pair of handles are arranged in connection with a generator, and a holder for a coin or other detached article is arranged in the circuit so that its presence is made to close the circuit.

374,528. Electric Gas Lighter; J. B. Entz, New York, N. Y. Application filed April 5, 1887. The gas pipe just below the tip serves as the hollow core of two coils. Valve mechanism is arranged inside the core, which is controlled by the armatures of the two coils or magnets. To ignite and turn on the gas the circuit is closed through one of the coils, and to extinguish the light the circuit is closed through the other.